

DEVELOPMENT OF MARITIME PATROL AVIATION
IN THE INTERWAR PERIOD, 1918-1941

A thesis presented to the Faculty of the U.S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree

MASTER OF MILITARY ART AND SCIENCE
Military History

by

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Fort Leavenworth, Kansas
2015

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REPORT DOCUMENTATION PAGE			<i>Form Approved</i> <i>OMB No. 0704-0188</i>		
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1. REPORT DATE (DD-MM-YYYY) 12-06-2015		2. REPORT TYPE Master's Thesis		3. DATES COVERED (From - To) AUG 2014 – JUN 2015	
4. TITLE AND SUBTITLE Development of Maritime Patrol Aviation in the Interwar Period, 1918-1941			5a. CONTRACT NUMBER		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S) LCDR Christopher J. Mergen, U.S. Navy			5d. PROJECT NUMBER		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Command and General Staff College ATTN: ATZL-SWD-GD Fort Leavenworth, KS 66027-2301			8. PERFORMING ORG REPORT NUMBER		
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; Distribution is Unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT The contributions of patrol aviation during World War II as the long-range patrol and reconnaissance arm of the U.S. Navy are well documented, but the development of its origins remain historically under-examined. The goal of this thesis is to perform an historical investigation of the influential forces that shaped the development of patrol aviation during the interwar period, 1918 to 1941. In order to form a thorough and objective argument, the research approaches these influential forces through an investigation from a strategic, technological, and operational perspective.					
15. SUBJECT TERMS Maritime Patrol Aviation, Interwar, General Board, World War Two, World War One, War Plan Orange, Innovation, Pacific Theater, Long-range Patrol and Reconnaissance, U.S. Fleet.					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. PHONE NUMBER (include area code)
(U)	(U)	(U)	(U)	172	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

MASTER OF MILITARY ART AND SCIENCE

THESIS APPROVAL PAGE

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1918-1941

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

DEVELOPMENT OF MARITIME PATROL AVIATION IN THE INTERWAR PERIOD, 1918-1941, by LCDR Christopher J. Mergen, 172 pages.

The contributions of patrol aviation during World War II as the long-range patrol and reconnaissance arm of the U.S. Navy are well documented, but the development of its origins remain historically under-examined. The goal of this thesis is to perform an historical investigation of the influential forces that shaped the development of patrol aviation during the interwar period, 1918 to 1941. In order to form a thorough and objective argument, the research approaches these influential forces through an investigation from a strategic, technological, and operational perspective.

ACKNOWLEDGMENTS

I would like to thank my thesis committee chair, Dr. John T. Kuehn, for his inspirational body of work, his mentorship, patience, and his expertise; Mr. Robert M. Brown and LCDR John R. Courtright, USN for their efforts and direction. I want to thank my parents, John and Ann Mergen for a lifetime of wisdom and inspiration; My in-laws Ken and Jackie Mundy for their unfailing faith. Finally, I must thank my wife Michele, and sons Joseph and Shawn, without whom I would not have a home port worthy of the return voyage and whose inexhaustible support has privileged me with the full application of my effort into not only this, but all my life's projection. I hope the work presented here is worthy of their sacrifice.

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ACRONYMS

ASW	Anti-Submarine Warfare
BuAer	Bureau of Aeronautics
BuC&R	Bureau of Construction and Repair
BuEng	Bureau of Engineering
BuNav	Bureau of Navigation
BuOrd	Bureau of Ordinance
CinCUS	Commander in Chief, United States Fleet
NAF	Naval Aircraft Factory
NWC	Naval War College
OP12	Office of the Chief of Naval Operations, War Plans Division
OpNav	Office of the Chief of Naval Operations
WW I	World War I
WW II	World War II

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CHAPTER 1

INTRODUCTION

Naval leadership during the interwar period facilitated the foundation of the first maritime force in history, which was no longer dependent on forward bases to sustain its initiative while seeking decisive battle in the reaches of the central and western Pacific.¹ This capability was the product of an evolution that spanned the interwar years and yielded the foundation for a navy able to consistently project power and dominate an enemy over vast distances of ocean.² This evolution required the collaboration, innovation, creativity, and foresight of a generation of naval leadership. This leadership, in the form of the General Board of the Navy (hereafter General Board), Commander in Chief, United States Fleet, (CinCUS), the Office of the Chief of Naval Operations (OpNav), and the Bureau of Aeronautics (BuAer), shaped the evolution of patrol aviation by their involvement in three essential areas: strategic necessity, technological development, and operational organization.

This thesis will attempt to investigate the development of patrol aviation within the context of the contemporary naval leadership of the period. Specifically the influence of the General Board, CinCUS, OpNav, and BuAer during the period 1918 to 1941. The contributions of patrol aviation during World War II (WWII) as the long-range patrol and

¹ John T. Kuehn, *Agents of Innovation: The General Board and the Design of the Fleet that Defeated the Japanese Navy* (Annapolis, MD: Naval Institute Press, 2008) xv, 177-179.

² Ibid.

reconnaissance arm of the U.S. Navy are well documented, but the development of its origins remain historically under-examined.

Background

The use of patrol aircraft by the U.S. Navy began with the naval action off Vera Cruz on 25 April 1914. Lieutenant Junior Grade Patrick N. L. Bellinger, piloting a Curtiss C-3 flying boat from the air detachment assigned to the USS *Mississippi*, reconnoitered enemy positions in Vera Cruz harbor and scouted for mines. Bellinger also provided air support to U.S. Marines at Tejar, Mexico, who had come under attack from revolutionary forces. On 6 May, Bellinger became the first naval aviator to receive hostile fire while flying a second mission near Veracruz.³ Despite the tactical advantages afforded by the use of aircraft, naval aviation grew slowly prior to World War I (WWI). The U.S. Navy entered the war with just thirty-eight aviation officers and 163 enlisted personnel to support naval aviation. From 6 April 1917 to 11 November 1918, that number swelled to more than 37,000 as the Navy employed aviation to combat the German submarine threat in the North Atlantic.⁴

The limited but significant role of patrol aviation in Anti-Submarine Warfare (ASW) and reconnaissance during WWI propelled the concept of a long range, multi-

³ Brian Johnson, *Fly Navy, A History of Naval Aviation* (New York: William Morrow and Co., 1981), 115.

⁴ Lieutenant W. W. Warlick, *U.S Navy Department of Seamanship and Flight Tactics U.S. Naval Academy, Naval Aviation: A text Book for the instruction of Midshipmen in the Department of Seamanship, U.S. Naval Academy* (Annapolis, MD: United States Naval Institute, 1929), 8-9.

mission maritime patrol aircraft through the interwar years.⁵ Navy leadership was responsible for refining the strategic, technological, and operational elements of patrol aviation in a developmental process that spanned twenty-three years. The problem of overcoming the vast geography of the Pacific led to the strategic pursuit of the fleet that the U.S. Navy went to war with in December of 1941.⁶ The Office of the Chief of Naval Operations, War Plans Division (Op12) relied upon the capabilities of a mobile, self-sustaining fleet to develop a strategy of advanced basing as it fought its way across the central Pacific.⁷ This concept lay at the heart of War Plan Orange, the Navy's blueprint for the naval war against Japan in the Pacific. Naval aviation was a key component of the Orange Plan and naval leadership spent the interwar period incorporating its strategic advantages to fill the tactical role as both maritime strike and fleet reconnaissance.⁸ The limitations in range and endurance of carrier-based aircraft led naval planners to pursue the capability of long-range patrol aircraft to solve the problem of scouting and reconnaissance for the fleet.⁹

The surprise defeat at Pearl Harbor was, in part, due to a failure in long-range reconnaissance. Of the six heavier-than-air (VP) squadrons of PBY-5 Catalinas totaling sixty-eight aircraft assigned to the Pacific Fleet, only one plane was airborne on the

⁵ Warlick, 117.

⁶ Edward S. Miller, "Eyes of the Fleet: How Flying Boats Transformed War Plan Orange," in *One Hundred Years of U.S. Naval Air Power*, ed. David V. Smith (Annapolis MD: Naval Institute Press, 2010), 31-32.

⁷ Kuehn, *Agents of Innovation*, xv, 125-127.

⁸ *Ibid.*, 117-118.

⁹ Miller, "Eyes of the Fleet," 41.

morning of 7 December 1941. In his essay “Eyes of the Fleet: How Flying Boats Transformed War Plan Orange,” from *One Hundred Years of U.S. Naval Air Power*, historian Edward S. Miller suggests that the reason for the oversight was that Admiral Husband E. Kimmel, Commander in Chief of the Pacific Fleet, opted to reserve the aircraft Oahu in an optimum state of readiness for the surge forward rather than wear them out patrolling in defense of Hawaii.¹⁰ On 6 December Japanese carriers were approximately 275 nautical miles northwest of Hawaii, well within the patrolling radius of the 1,000-plus nautical mile range of the PBY Catalinas. An often-overlooked tragedy of the Pearl Harbor defeat is that with the exception of the single airborne PBY, all sixty-eight Catalinas were destroyed on the ground or at their moorings.¹¹

The tactical defeat of the U.S. Navy at the Battle of Savo Island in August 1942 has historically treated the lack of adequate reconnaissance with a similar burden of proof. In Samuel Eliot Morison’s venerated *History of United States Naval Operations in WWII, Volume V: The Struggle for Guadalcanal August 1942-February 1943*, Morison cites the conclusion drawn by Admiral Arthur J. Hepburn in his official inquiry into the loss of the battle: “The primary cause for the defeat was the complete surprise achieved by the enemy.”¹² Morison determined that the first of many failures leading to the overwhelming Japanese tactical victory was the failure to effectively reconnoiter and report the enemy activity in the “obvious route between Rabaul to the Lower

¹⁰ Miller, “Eyes of the Fleet,” 41-42.

¹¹ *Ibid.*, 42.

¹² Samuel Eliot Morison, *History of United States Naval Operations in WWII, Volume V: The Struggle for Guadalcanal August 1942-February 1943* (Boston, MA: Little, Brown and Company, 1984), 62.

Solomons.”¹³ This vital line of communication was left to two B-17s from Espiritu Santo. A force whose limitations in range and numbers, to say nothing of training and inclination, missed the attacking force by a mere sixty miles.¹⁴

Though the lack of reconnaissance was an undeniable cause in some of the major U.S. naval defeats, these examples serve to highlight the contributions of patrol aviation in the Pacific War. It was, after all, PBY Catalinas from Midway that located the inbound Japanese landing force on 3 June 1942 and launched a moderately successful torpedo attack on the Japanese transport fleet that night.¹⁵ The situation was repeated the following day when the VP patrols located the Japanese carrier striking force.

One cannot discuss tactical success of patrol aviation in the Pacific War without mentioning the contribution of the Black Cats of VP-12 in the Guadalcanal Campaign. PBY-5A Catalinas were designated amphibian flying boats since they were also fitted with wheels for land-based operations from forward airfields. From December 1942 to February 1943, Black Cats operating from Henderson Field adopted night tactics to offset their obsolescence in armament and speed. They also utilized RADAR for targeting and navigation.¹⁶

Like the technological and operational pursuit of some of the more well-known contributors to the overall U.S. victory in the Pacific, patrol aviation was deliberately

¹³ Morison, 24.

¹⁴ Ibid.

¹⁵ W. L. Richards, report dated 18 June 1942, VP-44 Night Torpedo Attack, 3-4 June 1942. Copy of original provided to CDR (RET) John T. Kuehn by Archie Mills, USNR, one of the pilots on the mission.

¹⁶ Morison, 330-333.

developed by the naval leadership during the twenty-three years prior to going to war in 1941. Long-range maritime reconnaissance was an enabling strategic capability pursued by the leadership who built the treaty navy and designed the oceanic strategy of War Plan Orange.¹⁷ Scholarly interest—accumulated around the origins of the more overt contributors to the U.S. naval victory in the Pacific such as the aircraft carrier, amphibious warfare, and the U.S. submarine campaign—has obscured the significance of patrol aviation in its parallel origins.

U.S. Navy patrol aviation was an integral part of the strategic maritime force that evolved during the interwar years of 1918 to 1941. Patrol aircraft consisting of both VP and lighter-than-air (ZP) craft were essential supporting elements in the decisive naval campaigns of WW II. The ability to conduct long-range patrol and reconnaissance in support of the fleet from advanced bases played a key role in nearly all the major campaigns in the Pacific theater. From Pearl Harbor to Okinawa, the patrol wings of U.S. naval aviation, equipped with flying boats and their requisite seaplane tenders, fulfilled the vital role of long-range fleet reconnaissance, providing fleet security from advanced bases. The Navy also employed VP aircraft in the limited but significant role as a striking platform for offensive operations and as a mainstay for search and rescue.¹⁸

¹⁷ Edward S. Miller, *War Plan Orange: The U.S. Strategy to Defeat Japan 1897-1945* (Annapolis, MD: Naval Institute Press, 1991), 175, 179.

¹⁸ Richard Allen Hoffman, *The Fighting Flying Boat: A History of the Martin PBM Mariner* (Annapolis, MD: Naval Institute Press, 2004), 37. Flying boats were used extensively in Dumbomissions tasked to patrol for survivors in open ocean.

In his essay, "Eyes of the Fleet," Edward S. Miller sums up the strategic need that drove the pursuit of a long-range reconnaissance platform to support the U.S. Fleet's advance across the central Pacific:

The Navy lacked the means of intelligence of enemy whereabouts in a theater where island bases were vulnerable to attack from any point on the compass. Security would depend on aircraft that could search out a thousand miles in all directions. Such long-range scouts would also be critical for battle operations in open seas where hostile armadas might close upon each other by five hundred miles overnight. The aircraft carrier had introduced the frightening possibility of a superior fleet lost through inferior reconnaissance.¹⁹

Miller highlights the fundamental strategic need that drove the interwar development of patrol aviation as long-range fleet scouts.

The strategic concept of long-range reconnaissance evolved into an Op12 requirement because of the influence of restrictions established by the treaty system. In order to understand the conceptual evolution of long-range reconnaissance it must be examined in light of the influences of the treaty system of the 1920s and 1930s. The 1922 Washington Naval Treaty and the 1930 London Naval Conference, placed limitations on the force structure and strategic geography of the five nations who agreed to their terms.²⁰ Much of the strategic, technological, and operational development of patrol aviation during the interwar years was influenced by those limitations.

From the earliest days of flight, naval leadership in the form of the General Board and OpNav were invested in the strategic concept harbored in the potential of long-range reconnaissance and strike capability of the "flying boat."²¹ However, it took over two

¹⁹ Miller, "Eyes of the Fleet," 32-33.

²⁰ Kuehn, *Agents of Innovation*, 60-61.

²¹ B. Johnson, *Fly Navy*, 116.

decades of technological development after 1918 in order to produce an aircraft with the specifications needed to fight a naval war in the Pacific.²² By the mid-1920s the Navy had designated the aircraft as VP; V for heavier-than-air, and P for patrol.²³ However, the slow speed of development along with the need for a balanced fleet forced Navy leadership to pursue the lighter-than-air program as an alternative solution to the problem of range and endurance with respect to long-range reconnaissance aircraft.²⁴ In a parallel developmental effort, the Navy approached its material solution to the range and endurance problem by also pursuing rigid airship technology. Though the rigid airship program was discontinued by 1936, the Navy continued to innovate with non-rigid lighter-than-air technology until 1962 when airship operations were terminated.²⁵

In June 1940, Congress authorized forty-eight non-rigid airships or blimps for naval use. That number would later increase to 200. Overall, the Goodyear company would produce 134 of the K-type patrol airship designated ZNP-K (lighter-than-air, non-rigid, patrol, K-class). With a six-man crew, the K-class airships had a range of 1,900 miles and a maximum speed of sixty-eight knots.²⁶

During the war in the Pacific, the K-class airships of the Pacific Fleet were organized under Fleet Airships Pacific Command in Sunnyvale, California (NAS Moffett

²² Miller, *War Plan Orange*, 178.

²³ *Ibid.*, 175.

²⁴ John E. Jackson, "Ships in the Sky," in *One Hundred Years of U.S. Naval Air Power*, ed. David V. Smith (Annapolis, MD: Naval Institute Press, 2010), 43-44.

²⁵ *Ibid.*, 50.

²⁶ J. Gordon Vaeth, *They Sailed the Skies: U.S. Navy Balloon and the Airship Program* (Annapolis, MD: Naval Institute Press, 2005), 115.

field). The Blimprons operated in six to twelve-ship squadrons from bases in Santa Anna, CA and Tillamook, OR. Their mission was convoy escort, anti-submarine warfare, patrol, and open ocean rescue. By 1945, the K-class airships were armed with .50 caliber machine guns, depth bombs, and MK-24 mines.²⁷ The airships used RADAR, and Magnetic Anomaly Detection technology to aid in locating submerged U-boats. From 31 January 1942 to 1 September 1945, Pacific Fleet airships flew 167,291 hours in 20,156 flights escorting 11,000 ships and performed air-sea rescues along the west coast of the United States.²⁸ While the ultimate role of the lighter-than-air patrol craft of the U.S. Fleet may not have developed into the capability that interwar planners pursued, their contribution was measured and significant in both the Atlantic and Pacific Fleets.

The contribution of patrol aviation in the Pacific War first had to be designed, constructed, procured, organized, and operated before any of the abovementioned wartime achievements could be realized. Enormous technological and operational variables had to be solved during the period 1918 to 1941 to realize this strategic requirement imbued by war planners.

It is essential to examine naval leadership's relationship with the aircraft industry of the period. The Naval Aircraft Factory (NAF) in Philadelphia, PA was the primary source for seaplane research, development, and manufacturing of the Curtiss Flying Boat through the mid-1920s.²⁹ It was also the center for the prefabrication of the duraluminium

²⁷ Vaeth, 120-125.

²⁸ Ibid.

²⁹ Ibid., 176.

frames and helium bladders for the rigid airships *Akron* and *Macon*.³⁰ However, it was commercial industry that Navy leadership turned to in the mid-1930s to design and mass produce a patrol aircraft with the required 1,000 nautical mile range. The Consolidated PBY Catalina was the prolific backbone of the treaty navy's long-range reconnaissance component.³¹ The successful design, production, procurement, and integration of this aircraft stand as testimony to the evolutionary relationship between the U.S. Navy, the federal government, and private industry. It is also important to note that it was the Goodyear-Zeppelin Corporation that designed and produced the lighter-than-air craft. Navy leadership also leveraged commercial airlines for operational innovation. Pan-Air's Flying Clipper trans-Pacific air route hubs on Wake Island and the Philippines were established through U.S. federal land leases.³² These relationships were essential components to the development of patrol aviation. However, the material solution of designing and building capable aircraft was not an end in itself. Integrating the operational concept of long-range patrol aviation was the other side of the equation that interwar planners had to solve before this strategic capability could be fully realized.

As the design of the aircraft evolved through the interwar period so did the development of their operational employment with the fleet. The concept of operations to operate seaplanes from remote advanced bases performing long-range scouting for the fleet was conceived and refined during the interwar period. By January of 1944 the concept of seaplane tender and VP squadron operating as "sea-dromes" in advance of a

³⁰ Vaeth, 23.

³¹ Ibid., 175, 178.

³² Ibid., 239.

U.S. invasion was the successful wartime realization of the fruits of interwar development and planning.³³

The Marianas Campaign in the summer of 1944 precluded the use of land-based patrol planes from Eniwetok because it was over 1,000 miles away from Saipan. The distances made the use of tender-based flying boats a necessity to perform patrol and reconnaissance searches ahead of the landing force.³⁴ Finally, the opening battle of the Philippine Sea also known as the “Marianas Turkey Shoot” was initiated by the delayed contact report from a PBM Mariner patrolling from its forward station south of Saipan.³⁵ In the battle for the capture of Saipan, seven seaplane tenders and five VP squadrons of PBYs and P5Ms performed continuous patrol, reconnaissance, and rescue missions in support of the operation.³⁶ A similar operational battle rhythm was executed in the campaigns for Palau, the Philippines, Iwo Jima, and Okinawa.³⁷

A view from the operational perspective of patrol aviation in the Pacific War highlights the visionary development of interwar innovation with respect to the advanced basing concept. Throughout the interwar period, Navy leadership wrestled with the

³³ Hoffman, 37-41; Kuehn, *Agents of Innovation*, 92-98.

³⁴ Hoffman, 38.

³⁵ Ibid. “On 19 June Lieutenant H. F. Arles located an enemy fleet of forty ships 470 miles west of Guam. Unable to contact base because of radio communication problems, he was forced to deliver his contact report after landing approximately eight hours later. This delay precluded Admiral Spruance from launching a direct attack on the Japanese fleet but he was able to launch TF-58 aircraft in time to intercept the enemy attack aircraft as they approached the U.S. invasion forces. The resulting air battle became known as the Marianas Turkey Shoot. The opening battle of the Philippine Sea.”

³⁶ Ibid., 39.

³⁷ Ibid., 37.

operational synergy required to deploy patrol aviation with the fleet and sustain them with the use of seaplane tenders.³⁸ The study of interwar patrol aviation development cannot be complete without also addressing the evolution of the seaplane tender. Therefore, an investigation of interwar fleet structure is essential to understand how the operational organization between tenders and patrol squadrons evolved.

Primary Research Question

What were the strategic, technological, and operational factors that influenced the development of maritime patrol aviation during the interwar years (1918 to 1941) with respect to War Plan Orange?

In addressing the primary research question, several secondary questions will need to be addressed. From an analytical perspective, it is important to clarify the relationship between the parochial entities of the leadership that had a hand in patrol aviation development. It is essential to understand how that leadership interacted with outside organizations such as private industry, other militaries, the U.S. Army (including its Air Corps), and the U.S. federal government.

To understand the strategic necessity of patrol aviation it will be necessary to identify the early goals of the leadership concerning long-range reconnaissance along with how the concept evolved with respect to the innovation of a technological capability in its embryonic. Was it the success of the seaplane, embodied in the procurement of the PBY Catalina in 1933, or was it the failures of the heavier-than-air program personified by the fate of rigid airships *Akron* and *Macon* that helped shape the strategic role of patrol

³⁸ Kuehn, *Agents of Innovation*, 96.

aviation in support of War Plan Orange? What was the effect of the striking force debate over the role of VP aircraft as a potential bomber versus a strictly reconnaissance platform? Finally, from a strategic standpoint, what influence did the treaty system have on the development of patrol aviation?

To contextually understand the development of patrol aviation as a strategic capability, it is imperative to recognize its link to the technological evolution of the aircraft and airships. Primary and secondary source examination of the relationships between naval leadership and outside organizations is central to understanding how the strategic capability of patrol aviation was conceived, developed, produced, and sustained. What was the role of the naval leadership in the technological development of the seaplane and the rigid airship? What were the other organizational determinants that shared in the success and failures? What were the limitations encountered and how were they solved; by whom?

Finally, the investigation into how naval leadership developed the operational synergy required to tie in the strategic and technological capability of patrol aviation to the rest of the fleet opens questions of organization, training, employment, and sustainment. How did the leadership change their organization and employment of patrol aviation through the interwar period with respect to the strategic, technological, and geographic changes? What was their steady state? What annual training or major fleet exercises proved the operational concepts required for successful or unsuccessful patrol operations? What attention did leadership pay to the use of seaplane tenders and land based operational infrastructure that supported the lighter-than-air ships. Was the technological and operational evolution of the seaplane tender a limiting factor?

Limitations

While the majority of the primary source research was accomplished locally, the availability of certain sources required to thoroughly research this topic was a distinct limitation. Specifically, the reports from various exercises or “fleet problems” along with the war game analysis of the Naval War College (NWC) that provided contemporary planners with strategic and operational proof of concept were not directly available. The official records of the Bureau of Aeronautics (BuAer) and the records of the Naval Aircraft Factory would also be rich investigative source material. The travel funding required to conduct archival research abroad is non-existent. To investigate these sources would require visits to the NWC in Newport, RI and the National Archives in Washington, DC.

Secondary sources were sufficient to conduct the required background investigation in order to frame the context of patrol aviation as a supporting strategic capability essential to the formulation of War Plan Orange. To answer the question of strategic developmental influences there was a need to examine relevant external factors, such as treaty limitations, economic variables, and policies that shaped conceptual design and operational organization.

Though select secondary sources have produced excellent interwar scholarly analysis, any in-depth consideration given to patrol aviation development has been mainly general and supportive. It was necessary to investigate all aspects of technological aircraft design evolution from 1918 to 1941. Specifically the developments that produced the continued refinement of the flying boat and its requisite tender, along with the Navy’s

intrepid experiments with rigid airship technology to solve the problem of long-range aerial scouting.

Delimitations

It is assumed that the focus on the development of patrol aviation during the interwar years will remain fixed on the preparation for the war in the Pacific. The evolution of War Plan Orange and the building of the treaty navy was ultimately the driving force that created the need for a sea-based long-range aerial reconnaissance and patrol capability. The investigation of interwar lighter-than-air patrol craft is limited exclusively to the development of the rigid airships. As rigid airship technology was the only lighter-than-air craft the interwar Navy pursued to solve the problem of long-range patrol with the fleet. Non-rigid airship development was limited to coastal patrol and were understandably developed and organized differently.

Analytical Narrative

The thesis consists of five chapters. Chapter 1 introduces the research question, background, and limitations. Chapter 2 reviews a representative cross section of secondary source literature within the historiographical context of patrol aviation. Chapter 3 explores the post-WW I foundations of patrol aviation and examines strategic concepts, technological development, and industrial infrastructure from the years 1918 to 1921. The chapter focuses on the post WWI drawdown and the strategic shift to the Pacific. It also investigates the early technological development and procurement of new aircraft up to the 1922 Washington Naval Conference. Chapter 4 examines the period between the Washington Treaty and the London Naval Conference (1922 to 1931). It

investigates the strategic effects of the Washington Treaty along with how bureaucratic reorganization affected the development of material and operational solutions to the long-range scouting problem. Chapter 5 investigates the period after the London Naval Treaty (1932 to 1941) and examines the influences of treaty limitations on strategic need for patrol aviation. This chapter also examines the organizational innovation during the later stages of interwar development. The chapter traces the technological development of the successive aircraft design and the prioritization of seaplane tenders along with the land-based operational network that supported them. Particular attention will be given to understanding how the operational concept was developed and then tested in fleet exercises and annual training. Finally, chapter 6 provides conclusions for the impact of maritime patrol development and suggests the areas for continued analysis and research.

Methodology

The majority of the interwar literature concerning naval aviation is centered on the innovation of the aircraft carrier. With few exceptions, the focus on patrol aviation has been merely comparative and studied piecemeal. The strategic capability inherent in long-range reconnaissance, the technological design of the rigid airship and flying boat, and its operational relationship with the seaplane tender were innovations that contemporary leadership deliberately pursued in parallel with the rest of naval aviation. An historical analysis is needed to support the type of comprehensive examination required to discover the nuanced determinants that advanced the development of patrol aviation during in the interwar period.

Significance

The evolutionary context for the U.S. Navy's contemporary patrol fleet of P-8A Poseidons and P-3C Orions can be compared to the interwar years with several important parallels. These include a generation of leadership that reshaped the force in order to meet strategic goals, the integration of newly developed technologies to support those goals, and resource challenges in a fiscally constrained environment affecting organizational reform. A study of the organizational processes that balanced these variables and synthesized an enduring military capability with strategic, technological, and operational innovation is worth reflecting on for the present state of patrol aviation force evolution as well as its future.

There is limited literature analyzing the interwar development of patrol aviation. Insights into the pursuit of patrol aviation during the interwar period have ramifications for the advancement of corresponding capabilities currently evolving in the fleet today; specifically in the area of innovation at the strategic, operational, and technological level. The successes and failures that forged this lasting pillar of maritime aviation are worth studying.

CHAPTER 2

LITERATURE REVIEW

The role of patrol aviation during WWII as the long-range reconnaissance arm of the U.S. Navy is well documented. However, the complex development of this enduring capability remains historically under-examined. The interwar development of the central contributors to the naval victory achieved from 1941 to 1945 such as the aircraft carrier, amphibious warfare, and unrestricted submarine warfare have cast long analytical shadows over the deliberate and parallel efforts required to develop self-sustaining long range fleet air reconnaissance during the inter war years of 1919 to 1940.

While the contribution of patrol aviation during both world wars has been analyzed, the study of its origin has been only touched upon. Though much of the secondary literature concerned with interwar development of the U.S. Navy does include aspects of patrol aviation, there is no definitive source that examines the growth of the capability in its entirety.

In the introduction of their book, *American and British Aircraft Carrier Development 1919-1941*, Thomas C. Hone, Norman Friedman, and Mark D. Mandeles proposed that “there is a general revision of the more traditional notions about peacetime navies.”³⁹ This consideration is at odds with the traditional literature of naval aviation put forward by Samuel Elliot Morison, Robert O’Connell, Waldo Heinrichs, and others that have distilled the development of interwar naval aviation to a dualism between

³⁹ Thomas C. Hone, Norman Friedman, and Mark D. Mandeles, *American and British Aircraft Carrier Development, 1919-1941* (Annapolis, MD: Naval Institute Press, 1999), 3.

unimaginative battle ship admirals, against young, innovative irreverent airmen. Noted naval historian Geoffrey Till states that, “Such views are informed by the conception that technological change is a series of discrete jumps.”⁴⁰ This change in the literature has taken its place over the last forty years and can safely be said to have earned its rightful place with respect to longevity beside traditional interwar scholarship as a legitimate and commonly accepted viewpoint. It is from this viewpoint that the investigation of this thesis will be approached.

The majority of this contemporary interwar scholarship can be congregated with the several important parallels. They approach the interwar period of naval development with the understanding that the Navy which went to war in 1941 was conceived, built and operated from the origins of a deliberate innovative process whose contributing variables were complex and multidimensional. Those contributing variables include but are not limited to: a generation of administrative and operational leadership developing the present force in order to meet future strategic objectives, inter and intra-service competition within a resource constrained environment, and the integration of newly developed technology.

Charles M. Melhorn’s *Two-Block Fox: The Rise of the Aircraft Carrier, 1919-1929* (1974) examines innovation by investigating the development of carrier aviation during the interwar period. *Two-Block Fox* defines the dynamic of interwar carrier development as a power struggle over how to bridge the gap between the strategic commitments of the United States and the necessary naval force required to deliver that

⁴⁰ Geoffrey Till, “Adopting the Aircraft Carrier: The British, American, and Japanese Case Studies,” in *Military Innovation in the Interwar Period*, eds. Williamson Murray and Allen R. Millett (New York: Cambridge University Press, 1996), 192.

commitment.⁴¹ Melhorn challenges the traditional historical approach of interwar innovation; that of the old world conservative battleship admirals and their “Gun Club” against the new age technological mavericks whom championed the aircraft carrier as the revolutionary replacement weapons platform to take the Navy across the Pacific.⁴² The work acknowledges the fiction that the Navy turned to carrier aviation out of desperation for the losses sustained in the surprise attack on Pearl Harbor. He analyzes the U.S. pursuit of an offensive strategy in the Pacific: “By 1922 the situation in the Pacific had eroded to where it could not be corrected by conventional measures . . . This was recognized by a small but far-sighted group of officers in the Navy who saw no remedy short of a revolutionary advance in weaponry and tactics would suffice . . . It was their conviction that only through the development of the aircraft carrier could the Navy project it’s power into the western Pacific.”⁴³

Melhorn introduces the idea that there were other factors at work shaping the efforts of interwar innovators and strategic naval leaders of the period. *Two-Block Fox* departs from the traditional interpretation of the interwar years by analyzing the bureaucratic, organizational, fiscal, and administrative influences on the interwar development of the aircraft carrier. Melhorn views War Plan Orange and the Washington Naval Treaty as causal factors. This important step toward recognizing possible root

⁴¹ Charles M. Melhorn, *Two-Block Fox: The Rise of the Aircraft Carrier, 1919-1929* (Annapolis, MD: Naval Institute Press, 1974), preface, 1-2.

⁴² *Ibid.*, preface, 1.

⁴³ *Ibid.*

causes that united fleet planners toward common goals has also stimulated future research as part of an early departure from the more traditional interwar literature prior to 1974.

Melhorn also examines the complex relationships of the period's participants such as the General Board and the BuAer. Nevertheless, the intense focus on the direction of interwar carrier development isolates the innovation process with examples of interservice rivalry and competitive prioritization among factions of naval aviation during the period. Patrol aviation not only falls to the wayside in these analyses but also is identified as the shortsighted alternative to a proposed dichotomy in the direction of naval aviation development from its very beginnings. "The path of development defined by Eugene Ely's flight off *Birmingham* in 1911, which seemed clearly to be staked out in the direction of an aircraft carrier, took a sudden turn when later that year Glenn Curtiss lifted his hydro-aero plane from the waters of San Diego Bay."⁴⁴ The use of the seaplane at Vera Cruz proved the worth of naval aviation as the "eyes of the fleet" and fuels Melhorn's operational argument that interwar seaplane development was an impediment to the innovation required to create the aircraft carrier.⁴⁵

Melhorn dedicates much of his analysis to highlighting the incremental development of the aircraft carrier from an auxiliary ship responsible for the scouting, spotting, and air defense capability of naval aviation in support of the battler fleet, to the revolutionary striking arm that dominated the Pacific War. This incremental development is illustrated at the expense of patrol aviation whose development in support of the need

⁴⁴ Melhorn, 9.

⁴⁵ *Ibid.*, 9-10.

for long-range scouting kept the aircraft carrier from demonstrating its full potential.⁴⁶ Melhorn does attend to the interwar development of the seaplane, rigid airship, and the seaplane tender as a possible answer to the War Plan Orange strategic requirement for long-range scouting in support of the Battle Fleet. However, this attention is in support of a view that interservice competition inhibited the innovation of the aircraft carrier. He attributes this competition to existing wartime infrastructure problems, limited funding, post-war fixation on ASW capabilities, and personality arguments.⁴⁷ Seaplane tenders were only mentioned as an example of naval leadership leveraging inter-bureau politics to champion the seaplane over the carrier.⁴⁸

Melhorn's work does address the key developmental period for patrol aviation that took place in the decades following WWI. Specifically by comparing operational developments that produced the continued refinement of the seaplane and its requisite tender, along with the Navy's intrepid experiments with rigid airship technology to solve the problem of long-range scouting. Albeit, he does this by relying on portraying patrol

⁴⁶ Melhorn, 28. "The US Monopoly on helium mixed with the fact that proponents saw the dirigible as an ideal long range scout and range (the ability to roam beyond the battle lines tether) was one of the most fiercely resisted issues faced by carrier men . . . Functioning as a long range scout was a means of slipping the tether and demonstrating that the aircraft carrier was capable of independent operations. Dirigibles kept the aircraft carrier from proving this."

⁴⁷ Ibid., 30-31. "Thus existed, as the war (WWI) drew to a close, a clear cut difference in opinion as to how to develop naval aviation. There were conservatives, arrayed behind CNO Benson, who regarded naval aviation as a necessary evil. Useful on occasion for scouting and spotting, but always a handmaiden to the two decisive elements in naval war; the capital ship and the naval long rifle. This group visualized aviation as an auxiliary whose contribution could best be realized through the seaplane."

⁴⁸ Ibid., 29.

aviation as an administrative, organizational, and political hindrance to be overcome to enable the aircraft carrier as the predominate naval weapon of the Pacific War.

Melhorn introduces the idea that there were many variables shaping the efforts of interwar innovators and strategic naval leaders of the period. *Two-Block Fox* departs from the traditional interpretation of the interwar years with its analysis of the bureaucratic, organizational, fiscal, and administrative influences on the development of the aircraft carrier.⁴⁹ This advance in the scholarship toward recognizing possible root causes that created a unity of effort with respect to interwar innovation is seen “as part of a general revision of more traditional notions about peacetime navies.”⁵⁰ Edward S. Miller’s *War Plan Orange: The US Strategy to Defeat Japan* (1991) along with his essay, “Eyes of the Fleet: How Flying Boats Transformed War Plan Orange”, from the book, *One Hundred Years Of U.S. Navy Airpower* (2010) edited by Douglas V. Smith, examine the causal factors that contributed to the evolution of the treaty navy which the United States took to war in December of 1941. Like Melhorn, Miller’s work credits the more complex consideration of strategic and political determinants of interwar innovation. Miller challenges traditional views that the Orange Plan was a failure by hypothesizing that the Americans (and Japanese) developed naval power during the interwar years with a distinct strategic goal in mind.⁵¹ He proposes that this strategic clarity of a future conflict in the Pacific led to a unity of effort that served as an impetus to innovation. It is in this

⁴⁹ Melhorn, 1-5.

⁵⁰ Thomas C. Hone, Norman Friedmand, and Mark D. Mandeles, *American and British Aircraft Carrier Development, 1919-1941* (Annapolis, MD: Naval Institute Press, 1999), 1-3.

⁵¹ Miller, *War Plan Orange*, introduction, xix.

light of designing a force around a particular conflict maritime patrol arm of naval aviation is developed.

Miller hypothesizes that the American plan for an offensive maritime war against Japan led to the strategic pursuit of a fleet that could overcome the vast geography in the Pacific.⁵² This pursuit was marked through the interwar period by what Miller defines as the strategies of Thrusters and Cautionaries. Those that wanted to mass and drive the fleet through the central Pacific in a single campaign to relieve the Philippines (Thrusters), or those that preferred a longer but more methodical method of advancing through the central Pacific (Cautionaries).⁵³ Miller's research highlights that both strategies evolved through the interwar period with a requirement for the capability to conduct long-range aerial reconnaissance. "The Orange Plan naval force would require aircraft that could search 1000 miles to ensure the security of fleets and island bases, sea lines of communications, and open sea hostilities where armadas could close upon each other by 500 nautical miles overnight."⁵⁴

By framing the strategic problems faced by Orange planners, Miller outlines the causal relationships that both hindered and advanced innovation vis-a-vis the patrol arm of naval aviation during the interwar years. His research in these problem areas points to the post-WWI fixation with ASW, a weak and overly centralized command structure, along with a waning aircraft industry struggling to exist after the post-war cuts to

⁵² Miller, *War Plan Orange*, 32-33.

⁵³ Miller, "Eyes of the Fleet," 32-33.

⁵⁴ Miller, *War Plan Orange*, 175.

production. This situation was remedied in the mid-1920s by the creation of BuAer and its interaction with the General Board.⁵⁵

Miller credits much of the successful innovation during the interwar years to the bureaucratic foundations and relationships between BuAer, the General Board, the NWC, political leaders, and civilian aircraft industry executives. Admiral William A. Moffett was instrumental in the re-energizing of the post-WWI aircraft industry to sustain robust research and development as well as the infrastructure to support potential increase in production.⁵⁶

Miller emphasizes the importance of the 1930 London Naval Treaty that increased the need for aerial scouts when it put a cap on cruiser construction. This restriction served as an impetus for increased innovation in the field of long-range aerial reconnaissance.⁵⁷ The result was a diversification of research and development efforts to support the strategic requirements of War Plan Orange through the 1920s and into the mid-1930s. Patrol aviation split into the halves of rigid airships and flying boats. A technological race ensued that resulted in the creation of the PBY Catalina and the rigid airships *Akron* and *Macon*.

The impetus provided by the restrictions of the treaty system is an important distinction that marks the evolution of interwar literature. Miller recognizes the influence that the Washington and London Naval treaties had on the overall strategy of War Plan Orange and illustrates the effect by highlighting the Cautionaries final victory over the

⁵⁵ Miller, "Eyes of the Fleet," 33-34.

⁵⁶ Ibid.

⁵⁷ Ibid.

Thrusters. The prohibition of forward basing in the central Pacific precluded any hope for anything but a self-sustained methodical march through the mandates on the way to the Philippines.⁵⁸ This idea is developed to unprecedented depth in John T. Kuehn's *Agents of innovation: The General Board and the Design of the Fleet that Defeated the Japanese Navy* (2008). Miller's insight about patrol aviation from an organizational perspective is a rarely visited aspect of interwar literature. This important examination illustrates the struggle that the contemporary leadership had to nest innovative capabilities within the force they were designed to support.⁵⁹

Miller continues his investigation through the 1930s by highlighting the mission evolution of patrol aviation in its uncertain role from support of the Scouting Fleet, Battle Fleet, Fleet Base Force and finally back to Scouting Fleet. While Miller's work contains some of the most in-depth research concerning interwar patrol aviation, it only briefly touches on the operational component of the aircraft tender development as it relates to the support of the long-range reconnaissance role of the seaplane. Article XIX of the 1922 Washington Naval Treaty prohibited the United States from building new or augmenting existing forward bases in the western Pacific. The operational problem of self-sustainment necessitated by article XIX, created the need for massive innovation on the operational level of naval warfare to include seaplane tenders for the newly developed VP squadrons. The question on how to base the patrol squadrons west of Hawaii led to a series of innovative experiments that ended in the adoption of the seaplane tender

⁵⁸ Miller, "Eyes of the Fleet," 33-34.

⁵⁹ *Ibid.*, 35-38.

concept.⁶⁰ Miller draws on evidence found in the reports from annual Fleet Problems and hearings from the General Board to note that the aircraft tender was identified by the fleet as a distinct weakness during the entire interwar period.

Another work that takes a nuanced view of interwar naval development is *Battle Line: The United States Navy 1919-1939*, by Thomas C. Hone and Trent Hone (2006). Like the more traditional interwar literature, the work recognizes the polarity of the Navy itself as it developed through the interwar years. “The Navy of the 1920s and 1930s was an incredible amalgam of the old and the new, of the traditional and the unorthodox, and the future and the past . . . the Navy, like so many of this nation’s enduring institutions, was caught trying to straddle a fence between the world wars.”⁶¹ Unlike the traditional literature previously mentioned, *Battle Line’s* approach to this polarity is not critical of the interwar Navy as a parochial institution that failed to prepare the fleet for WWII. The work analyzes a variety of influences on the development of the interwar Navy. *Battle Line* animates the composition of the fleet with evidence wrought from institutional, economic, and political perspectives. The result depicts the identity of interwar navy found within the structure of how it planned to fight.

To shape an institutional perspective, Hone dissects the process of innovation with respect to the refinement of fleet capabilities. Referencing the General Board

⁶⁰ Miller, *War Plan Orange*, 75. In reference to Article XIX of the Washington Naval Treaty, “the U.S. was compelled to find alternate ways for fighting without a prepared base on far-away seas which would require range, endurance, and self-sustenance. Each rejection stimulated innovations that met those needs.” Referring to the interwar innovations of coal to oil, underway replenishment, and mobile dry-docks, long-range reconnaissance, and battleship modernization.

⁶¹ Thomas C. Hone and Trent Hone, *Battleline, The United States Navy, 1919-1939* (Annapolis, MD: Naval Institute Press, 1991), introduction, xvi.

hearings in 1919, the NWC studies of the Battle of Jutland, the annual Fleet Problems that evaluated strategic assumptions, the fiscal challenges of the period, and the effects of the arms limitation treaties of the 1920s and 1930s, *Battle Line* provides evidence that the interwar navy evolved through a period of great multi-dimensional complexity.⁶² The chapter by the Hones on naval aviation hypothesizes that the interwar Navy had institutionalized a mechanism of cyclic innovation to navigate the complexity of the period. Hone outlines the process from technological development to strategic capability by devoting an entire chapter to naval aviation as an example of this innovative complexity. BuAer provided technological capabilities to the NWC, which then researched viability through, war gaming. These results were tested in the annual Fleet Problems. The evaluation of these exercises were then provided to the General Board and OpNav for eventual feedback to BuAer to continue technological development.⁶³

The Hones prove that through this complexity, the naval service was forced to find strength in that polarity between traditional and the unorthodox. That strength is resident in the deliberate and methodical innovation of the Battle Fleet through the interwar period. “The Battle line formed the basis for tactical thinking, but gunfire alone could not win the battle. Combined weapons of the entire fleet would be needed.”⁶⁴ Evidence of this combined arms approach is highlighted in the book’s repeated reference to the Fleet Battle Problems between 1934 and 1939.

⁶² Hone and Hone, *Battleline*, 4.

⁶³ *Ibid.*, 91-92.

⁶⁴ *Ibid.*, 86.

The economic and political determinants of interwar development highlighted the positive relationships between the Navy and political leaders. The Naval Parity Act, the Naval Expansion Act, and the conclusion of the debate between the Navy and the advocates of unified airpower, which led to the creation of BuAer, were all used by the Hones as evidence of positive relationships that were fostered through complicated and diplomatic times.⁶⁵ Like Melhorn, the Hones analyze a variety of influences on the development of the interwar Navy. *Battle Line* animates the composition of the fleet from institutional, economic, political perspectives while keeping with the traditional view of interservice polarity. The Hones acknowledge this dynamic as a positive, realistic, and necessary complication to the new course the Navy had set during the interwar decades.

Like Miller, John T. Kuehn's book *Agents of Innovation: The General Board and the Design of the Fleet that Defeated the Japanese Navy*, (2008) challenges the critical view that the United States was not ready for war when it came in 1941. This traditional view hypothesizes that the limitations posed by the 1922 Washington Naval Treaty were detrimental to the fleet's preparation to execute War Plan Orange.⁶⁶ Kuehn builds upon the scholarship of Miller to develop the viewpoint that the U.S. dedication to War Plan Orange was the strategic impetus that generated the unity of effort required to bind the naval service to a common goal. While Kuehn acknowledges War Plan Orange as the strategic foundation, he identifies the 1922 Washington Naval Treaty, with its limitations on capital ship construction and particularly the prohibition of forward basing in the Fortification Clause of Article XIX, as the "root cause which channeled innovation in the

⁶⁵ Hone and Hone, *Battleline*, 15-17.

⁶⁶ Kuehn, *Agents of Innovation*, 1-2.

interwar Navy.”⁶⁷ This perspective stands in contrast to the traditional interwar literature that “paints the U.S. Navy as aristocratic, conservative, and hostile to change.”⁶⁸ Like the works of Melhorn and Miller, Kuehn recognizes the causal variables that shaped the way the interwar Navy chose to prepare for the conflict in the Pacific. Kuehn’s approach to the subject of the interwar Navy from a strategic, organizational, and bureaucratic perspective hypothesize a nuanced view that the interwar Navy was a deliberately innovative institution.⁶⁹

Agents of Innovation examines the tactical, operational, and strategic context that framed interwar innovation with respect to the circumvention and overcoming of the Fortification Clause of the 1922 Washington Naval Treaty. The work specifically illuminates the role of the General Board as the epicenter where treaty implementation, building policy, and war planning intersected.⁷⁰ The research is focused on interwar programs that characterize innovation such as battleship modernization, naval aviation, and the mobile basing concept.

⁶⁷ Kuehn, *Agents of Innovation*, 1.

⁶⁸ *Ibid.*

⁶⁹ *Ibid.*, 2.

⁷⁰ *Ibid.*, preface, xv. “The General Board and by extension the U.S. Navy was forced to consider how to project power in the far reaches of the Pacific without secure land bases for shore-based logistics. This in turn led to the development of a measurably different fleet than would otherwise have been built. A fleet that was more suited to the vast reaches of the Pacific because it could operate nearly autonomously from the sea. The treaty built fleet in a variety of innovative programs and initiatives reflected this new conception of sea power. These included advanced mobile bases, embarked naval aviation, long radius of action surface ships and submarines as the principle elements. The Fortification Clause of the Washington Naval Treaty was the unintentional father—and the General Board the midwife—of the modern power projection fleet. Especially its sea basing component—the critical core of the USN in the 21st century.”

Kuehn examines development of naval aviation as an operational means to apply sea power but does not limit his research to just the aircraft carrier and its embarked air wing. By highlighting the organizational relationships between the General Board and BuAer as they “advocated a balanced naval air concept” through the 1920s, Kuehn emphasizes that the vision of senior naval leadership was a catalyst for innovative options like the flying deck cruiser, lighter-than-air craft, and the mobile basing concept resident in the interwar struggle to develop the aircraft tender (designation AV).⁷¹ Kuehn devotes an entire chapter to interwar aviation development with respect to the Article XIX limitations and sheds a great deal of light on the development of the aircraft tender. Using hearings from the General Board, Kuehn illuminates the struggle that naval leadership had with developing this concept.

Both Miller and Kuehn, and to a lesser extent the Hones, have developed some of the central causal factors that served to invigorate and focus the efforts of U.S. naval interwar innovation. What illumination Miller sheds on the stimulating effects of War Plan Orange, Kuehn sheds equally on the Fortification Clause of the 1922 Washington Naval Treaty. Both scholars rely heavily on evidence made available in the *Proceedings and Hearings of the General Board of the U.S. Navy*. The evidence wrought from the literature on this subject points to the General Board as the locus that binds the more recent revision of the traditional notions about the interwar Navy.

Geoffrey Till’s essay, “Adopting the Aircraft Carrier: The British, American, and Japanese Case Studies” from the book, *Military Innovation in the Interwar Period*, edited by Williamson Murray, and Allen R. Millett (1996), uses interwar maritime air power as

⁷¹ Kuehn, *Agents of Innovation*, 89-91.

a means to investigate the larger matter of military innovation. The essay focuses on carrier innovation but does acknowledge the role of land-based maritime aircraft as “vastly extending reconnaissance at sea . . . offering an effective means of attack on enemy warships and maritime commerce.”⁷² Till hypothesizes that “Great Brittan, Japan and the United States failed to fully realize the contribution that airpower could make to the conduct of war at sea.”⁷³ Till’s essay investigates the interwar development of carrier aviation as evolutionary and not incremental. He credits the more complex consideration of strategic and political determinants of interwar innovation. This consideration is at odds with the traditional literature of naval aviation that distills the development of interwar naval aviation to a dualism between unimaginative emotional battle ship admirals, against young, innovative irreverent airmen. “Such views are informed by the conception that technological change is a series of discrete jumps.”⁷⁴

An important insight highlighted by Till’s essay was the acknowledgment that the Americans (and Japanese) developed naval air power during the interwar years with a distinct strategic goal in mind. Unlike the British, planning, training, and equipping for war in the Pacific enabled the United States and Japan to refine their strategic priorities into criterion with which to evaluate tactics and equipment. “The American ability to point at the Japanese as a clear potential opponent was an asset in many ways.”⁷⁵ He proposes that the strategic clarity of future conflict in the Pacific led to a unity of effort

⁷² Till, “Adopting the Aircraft Carrier,” 191.

⁷³ Ibid.

⁷⁴ Ibid., 192.

⁷⁵ Ibid., 203.

that served as an impetus to carrier innovation and that the United States was bonded with a “collective sense of mission.”⁷⁶ This idea is developed in Edward Miller’s *War Plan Orange*. It is in this light of designing a force around a particular conflict that Till examines the maritime patrol arm of naval aviation. Till acknowledges that the aerial reconnaissance and gunnery spotting were among the main priorities of the fleet air arm during the interwar period.⁷⁷

Interservice parochialism was another shaping mechanism that affected innovation of interwar carrier aviation. Till highlights the difference between the British and American naval air arms. Specifically, Till highlights the independence and continuity that was provided by the creation of the BuAer as compared to the centralized system of the Royal Air Force. This organizational foundation gave BuAer’s leadership a strong bureaucratic unity of effort among military, political, and industrial constituencies. Till highlights the relationships between Admiral William A. Moffett (BuAer), Representative Carl Vinson (Chairman of House Naval Affairs Committee) and the General Board, as a “pluralistic decentralization” that allowed naval aviation to develop during the 1920s and 1930s.⁷⁸

Naval War College Newport Papers 37, “Innovation in Carrier Aviation,” by Thomas C. Hone, Norman Friedman, Mark D. Mandeles (2011) is a study dedicated to the development of carrier aviation as it contributes to the larger study of innovation. The entire first chapter of the monograph is dedicated to BuAer prior to WWII. Hone,

⁷⁶ Till, “Adopting the Aircraft Carrier,” 205.

⁷⁷ *Ibid.*, 215.

⁷⁸ *Ibid.*, 211.

Friedman, and Mandeles investigate the organization of BuAer as a bureaucratic entity, which served as the epicenter for aircraft design, production, procurement, and codification of basic doctrine in the 1920s and 1930s. The research highlights BuAer's relationships with private industry, overseeing the output of the NAF as well as controlling contracting and design competitions with civilian firms. Hone, Friedman, and Mandeles, not surprisingly, credit much of the organizational success to Admiral William A. Moffett (BuAer from 1921 to 1933). His leadership put into motion an innovative machine that was able to move from requirements to specification to design to production in a minimal amount of time. (three years in the case of the Dauntless dive-bomber).⁷⁹ This efficiency was thrown into high gear in the 1930s by the Navy's pursuit of carrier aviation, but the work traces the bureaucratic foundation from the 1920s when the Navy was continuing development of an acceptable long-range maritime patrol platform for scouting and spotting.⁸⁰ It is the depth of their research into the bureaucratic institutions, which shaped naval aviation that makes this work important. Specifically, the relationship between naval leadership and the interwar aircraft industry as it pertains to the technological innovation that produced a viable strategic capability.

One Hundred Years of U.S. Naval Air Power edited by Douglas V. Smith (2010) is a collection of essays that highlight the contributions of naval aviation to American history over the last century. The wide aperture of the investigation lends itself to consider a thorough and well-balanced approach to the subject matter. Nearly half of the

⁷⁹ Thomas C. Hone, Norman Friedman, and Mark D. Mandeles, *Naval War College Newport Papers Thirty Seven: Innovation in Carrier Aviation* (Newport, RI: Naval War College Press, August 2011), 11-12.

⁸⁰ Ibid.

book is dedicated to the interwar period and includes the nuanced viewpoints of the complex causal relationships of interwar development as they pertain to naval aviation. Smith's scholarship takes advantage of the luxury provided by the revisionist viewpoints about the interwar period established by Miller, the Hones, and Kuehn. The essays do not spend time delineating the difference between the duality of battleship admiral against maverick aviator that defined much of the early interwar scholarship. They instead highlight the multiplicity of determinants that drove the innovation and development of naval aviation. This is perhaps a sign that the claims of revisionists like Miller, the Hones, Kuehn, and others have taken root in the contemporary scholarship; inspiring a movement of in-depth research into the rich complexity that the source material surviving the interwar period has to offer.

In the pursuit of creating a thoroughly representative glimpse at interwar naval aviation, Smith makes room for highlighting areas of interwar aviation development that are often footnoted in the discussions of strategic carrier development or used as comparisons of failure to highlight incremental changes in technological developments or bureaucratic prioritization. The development of patrol aviation is analyzed in a number of essays including John E. Jackson's, "Ships in the Sky." Smith's work investigates the interservice debate over how to best develop patrol aviation in the interwar period. Jackson uses correspondence to the General Board along with BuAer's relationships with private industry to highlight the innovative voyage that marked the debate between the capabilities offered by heavier-than-air or lighter-than-air craft to solve the problem of

long-range reconnaissance in support of the Battle Fleets execution of War plan Orange.⁸¹

Jackson highlights influence Admiral William A. Moffett had on the success of interwar development of naval aviation. The essay traces the process from strategic concept to production and testing and presents it as a testimony to the innovative machine that BuAer had become under Moffett's leadership by the late 1920s. Though the rigid and non-rigid airship development is normally footnoted as a failure and a waste of resources that could have been better spent on other areas of aviation, Jackson's research brings attention to the very real strategic potential of the lighter-than-air capability. The efforts to actualize this potential illustrate the complexity of determinants that modern interwar scholars like Kuehn and Miller have hypothesized as the hallmark of the innovative period between the world wars.

Albert A. Nofi's essay "Aviation in the Interwar Fleet Maneuvers, 1919-1940" is a summary of the twenty-one "Fleet Problems that the Navy used to evaluate interwar tactics operations and strategic concepts."⁸² Nofi focuses on the evolution of carrier aviation with respect to the Fleet Problems of the 1920s and 1930s, but he gives due attention to the "other forms of naval aviation;" battleship and cruiser float planes, flying boats, land-based aircraft, and rigid airships among them.⁸³ The majority of the research for the essay that concerns patrol aviation was in the later Fleet Problems from 1930 on.

⁸¹ Jackson, 43.

⁸² Albert A. Nofi, "Aviation on the Interwar Fleet Maneuvers, 1919-1940," in *One Hundred Years of U.S. Naval Air Power*, ed. David V. Smith (Annapolis, MD: Naval Institute Press, 2010), 94.

⁸³ Nofi, 94-95.

It was by then that the increased range of the flying boat along with the rigid airship program had solved the technological problem of the need for long-range patrol.⁸⁴ It is in the Fleet Problems that much of the interwar literature points to the decisive proof of concept with respect to the debate over the role of patrol aviation (and naval aviation in general). It is also here that the refinement of ongoing innovative programs were ultimately decided. Nofi highlights the key lessons learned which the post-exercise reports illuminate as key issues in the future development of naval aviation. From 1934 to 1939 all of the reports, mention patrol aviation in the form of seaplanes, tenders, and rigid airships.⁸⁵ Nofi also highlights the interservice debate over the role of the seaplane as an additional fleet strike aircraft in addition to long-range reconnaissance. This debate took place at the highest levels of naval leadership.⁸⁶

The essay was an in-depth look at the role Fleet Problems played in the refinement of innovative technologies, tactics, and operational doctrine as they pertained to naval aviation. While the focus was on carrier aviation development, the amount of detail that Nofi communicated with respect to patrol aviation is indicative that they were deliberately linked to a balanced approach to the integration of newly developed capabilities into the fleet.

The majority of the interwar literature concerning naval aviation is centered on the innovation the aircraft carrier. With the exception of Miller, the Hones, Kuehn, Smith, and some others, the focus on patrol aviation has been merely comparative and studied

⁸⁴ Ibid., 101-104.

⁸⁵ Ibid., 109-121.

⁸⁶ Ibid., 123.

piecemeal. The developments of lighter-than-air craft, the seaplane tender, and the evolution of the flying boat, represent the strategic, operational, and tactical aspects of patrol aviation that were deliberately pursued alongside the rest of naval aviation. The secondary literature that examines the period from the 1920s to the 1930s does include aspects of patrol aviation, but has yet to comprehensively examine the evolution of this enduring capability in its entirety.

Patrol aviation was an integral part of the force that evolved during the interwar years of 1919 to 1940. Long-range reconnaissance was an enabling strategic capability that was actively sought by the naval leadership who built the interwar Navy. The change in the literature that has taken its place over the last forty years continues to inspire study of treaty fleet that went to war in 1941. This thesis will examine one of the more overlooked aspects of naval aviation in the light shed by the scholarly progression into the subtleties and nuanced determinants of interwar innovation.

CHAPTER 3

1918 to 1921: POST-WAR FOUNDATIONS

Evolution of War Plan Orange and the building of the treaty navy were ultimately the driving forces that created the need for a self-sustaining, long-range aerial patrol and reconnaissance capability. The Navy spent the interwar years developing a means for which this capability could operate in support of the main Battle Fleet for engagements across the vast reaches of the Pacific Ocean. However, evidence suggests that from the end of WW I until the 1922 five power treaty in Washington, naval leadership was more focused on re-equipping and re-organizing its post-war fleet based on lessons learned from the conflict in Europe rather than the strategic development of a fleet capable of conflict in the Pacific with Japan.

Though the operational concept of fleet-based aircraft was discussed by the General Board as early as August 1917, the majority of U.S. naval aircraft development during WW I centered on a strategy of coastal patrol and convoy escort.⁸⁷ These two mission sets were strategically aligned to provide the capability necessary to counter the German submarine threat to allied sea lines of communication in the North Atlantic. However, without a prepared force, the technology of the day dictated the capability that the United States could bring to bear as a military solution to any strategic problem involving naval aviation.

The U.S. Navy had few fixed-wing or heavier-than-air craft at the start of the conflict. The lighter-than-air craft, in the form of the kite balloons and dirigibles did not

⁸⁷ Warlick, 7.

see naval service until March of 1917.⁸⁸ From a manpower perspective, the United States entered the war in April 1917 with 201 men on aviation duty. When the armistice with Germany was signed, just over a year and a half later, there were over 37,000 men assigned to aviation duty.⁸⁹ This improvised emergency expansion forced the Navy to spend the majority of the war years erecting its design, construction and operational doctrine to fit the parameters of the conflict in Europe. The United States was forced to consider modeling its design and production efforts on the allied powers of Britain, France, and Italy, who had already established design and production infrastructure.⁹⁰ The Navy correspondingly shaped its standing operational framework based on the tactical success learned from observation of relevant engagements involving aircraft in the Atlantic and the North Sea.

The General Board actively discussed British ASW patrol operations from the coast, along with engagements involving naval aircraft in the Bight of Helgoland and the Christmas raid on Cuxhaven in 1917 (where attacks were flown from special airplane

⁸⁸ William Trimble, *Wings for the Navy: A History of the Naval Aircraft Factory, 1917-1950* (Annapolis, MD: Naval Institute Press, 1990), 3-4.

⁸⁹ Lieutenant R. D. Kirkpatrick's address to the board on the "best method to secure and retain personnel." National Archives and Records Administration, General Records of the Department of the Navy, Record Group 80, *Archival Information Proceedings and Hearings of the General Board of the U.S. Navy, 1900-1950*, Combined Arms Research Library, Fort Leavenworth, KS, Microfilm, 1919, vol. 3, 788. Hereafter referred to as NARA, PHGB,. Note: page numbers refer to microfilm page numbers assigned by NARA not the page numbers from the transcripts.

⁹⁰ The General Board held hearings in 1917-1919, to discuss reports of overseas trips to visit both the heavier-than-air and lighter-than-air, design, production, and operations in England, France, Italy, and, after the armistice, Germany. NARA, PHGB, 1918, vol. 2, 603-614; 1919, vol. 2, 603.

carrier ships).⁹¹ Along with revealing general tactics of how to operate within the modern battle line, the Battle of Jutland was intensely studied for its lessons on long-range fleet reconnaissance. The continued examination of this engagement shaped the future role of aircraft in support of the fleet in open sea engagements. Specifically the role of aerial reconnaissance provided by the rigid airships of the German Navy.⁹²

By November of 1918, the operational and technological pursuit of naval aviation had culminated in the development of two varieties of patrol aircraft to support the maritime strategy of the United States in the European theater: heavier-than-air craft and lighter-than-air craft. During the post-war, reorganization of the U.S. Fleet the General Board wrestled with the technological strengths and weaknesses, strategic roles, and operational feasibility of these two very different aeronautical approaches to fleet patrol and reconnaissance. The way forward was ultimately to create a balanced fleet that incorporated the new advantages of aviation into the existing Battle Fleet construct that the rest of the major world powers were operating under in the wake of the 1917 Battle of Jutland.⁹³

Along with the evolution of the overall U.S. Fleet, the post-war drawdown and reorganization served to re-focus developmental efforts of the U.S. Fleet on the future role of U.S. naval aviation in general. However, the paradigm carved from the Navy's reactive participation in WW I would not be fully shifted until 1922. The continued

⁹¹ NARA, PHGB, 1917, vol. 1, 21-23.

⁹² "Naval Aviation Policy: Lighter-Than-Air," 21 April 1919, NARA, PHGB, roll 14, vol. 3, 722-733.

⁹³ Kuehn, *Agents of Innovation*, 6.

operational reorganization of the U.S. Fleet, centralization of U.S. naval policy toward aviation in the form of the BuAer, and the limitations of the Washington Naval Treaty, became the primary determinants that fostered patrol aviation development through the 1920s.

Heavier-than-air Craft through the End of WW I

The Navy's pursuit of a heavier-than-air capability for long-range scouting was exhibited in the interwar development of the flying boat. Other than the Curtiss Aeroplane Company, the industrial infrastructure for large-scale aeronautical research, production, and development had yet to be established in the United States. The reasons for the singularity of design and production of the flying boat were two-fold. The strategic need for coastal patrol and convoy escort to protect against the submarine threat, and the lack of design and production infrastructure resident in the United States. These two factors ultimately decided the direction of aeronautical development during WW I.

The Curtiss Aeroplane and Motor Company, founded by Glenn H. Curtiss in 1908, designed and produced the most prolific and successful flying boats of WW I. The H-4, H-8, and H-16 "Large America" series "claim the distinction to be the first type of combat-capable aircraft to be produced in the United States during WW I."⁹⁴ All variants from this series of flying boat were exported to Great Britain both before and after the United States entered the conflict in April 1917. The U.S. Navy accepted its first H-16 in February of 1918 and follow-on orders grew quickly enough to include the NAF as a source of licensed production in order to maintain pace with wartime demand. Large

⁹⁴ E. R. Johnson, *American Flying Boats and Amphibious Aircraft: An Illustrated History* (Jefferson, NC: McFarland and Company, 2009), 41-42.

America's built in the NAF were designated F-5-L and were powered by two 420-horsepower Liberty-12A engines giving the F-5-L a maximum range of 830 miles. In all, 426 H-16/F-5-Ls were produced and remained in U.S. naval service until the late 1920s.⁹⁵

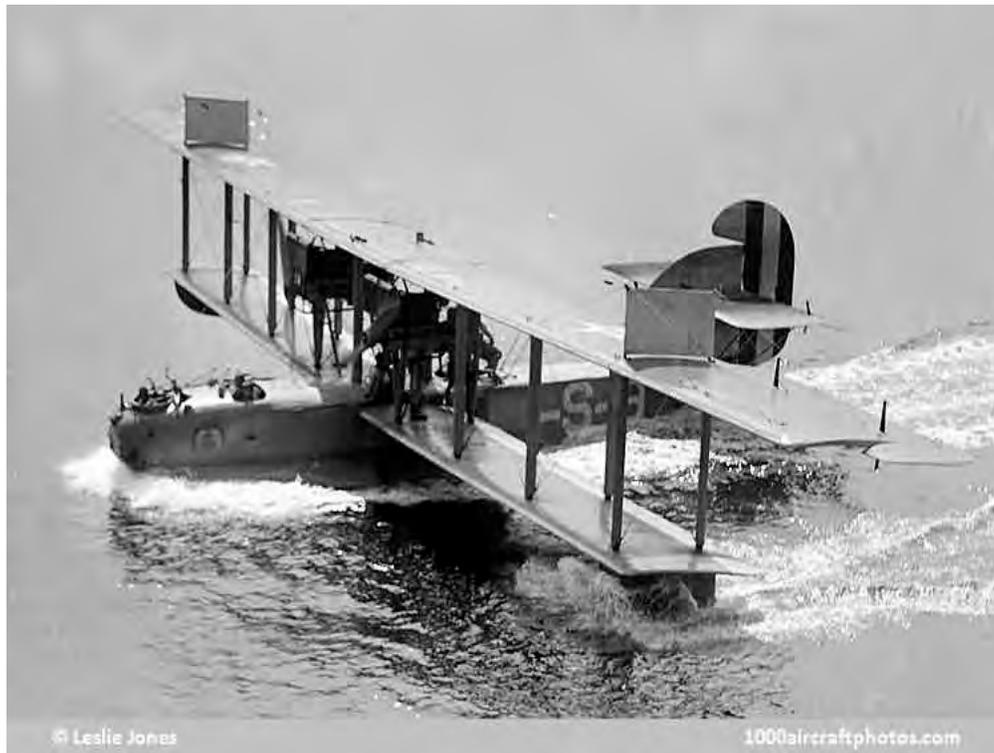


Figure 1. Curtiss F-5-L

Source: Leslie Jones Collection, No. 11996, “Curtiss F-5-L US Navy,” Photographed at Newport Harbor by Leslie Jones, courtesy Boston Public Library, 1000Aircraft Photos.com, accessed 19 April 2015, <http://1000aircraftphotos.com/Contributions/JonesLeslie/11996.htm>.

⁹⁵ E. R. Johnson, *American Flying Boats and Amphibious Aircraft*, 41-42.

The HS series flying boat was the most prolific of the American-built WW I Flying Boats. The HS-2L was first produced by Curtis in the spring of 1918. It was powered by one 350-horsepower Liberty-12 and had a range of 517 miles. There were 1,151 variants of the HS aircraft produced, and they were kept in service as single engine trainers until the late 1920s.⁹⁶ The third type of aircraft built by Curtiss for WW I was the NC-series flying boat. Powered by four 420-horsepower Liberty 12-A engines giving it range of 1,470 miles, the NC was the largest and longest range H/A craft produced by the United States at that time. The design came from a 1917 U.S. Navy requirement for a flying boat that could achieve transatlantic range for prolonged ASW patrols.⁹⁷

Although four NC aircraft were produced before the 1918 armistice, none saw wartime service. However, the technological achievements of the NC series aircraft did serve to propel continued post-war interest in long-range seaplane development for use in the Pacific. On 31 May 1919, the U.S. Navy successfully completed the world's first transatlantic flight. The flight plan for the three NCs to cross the Atlantic was divided into five legs taking off from Rockaway Beach, New York for the 540-mile leg to Halifax, Nova Scotia; 460 miles to Trespass Bay, Newfoundland; 1,200 miles to the Azores (Portugal); 800 miles to Lisbon, Portugal; and 775 miles to Plymouth, England. Only one of the three aircraft that took off on the morning of 8 May 1919 completed the 3,875-mile twenty-three-day journey. Two of the aircraft were damaged while landing in

⁹⁶ E. R. Johnson, *American Flying Boats and Amphibious Aircraft*, 41-42.

⁹⁷ *Ibid.*, 46.

the Azores, the first being abandoned at sea and the second jury-rigged sails to make it as far as Sao Miguel Island.⁹⁸

The relatively short range of the H-16/F-5-L, and the HS-2L (300-500 miles) was a limiting factor in the strategic prospect of basing these first generation flying boats of this type with the fleet for use as long-range scouts. Range and endurance precluded the flying boat as a strategic asset capable of anything more than coastal patrol and land-based convoy escort. The following excerpt from *Naval Aviation, A Text Book for the Instruction of Midshipman in the Department of Seamanship at the U.S. Naval Academy* (1929) openly recognizes the strategic limitation of naval aviation in WW I:

Naval Aviation in the World War was, of necessity, a deviation from the policy of application to fleet needs. It will be remembered that at the time of our entry the submarine menace was the greatest danger. Naval aviation therefore concentrated on this problem. Another great naval activity was the convoy and escort of troop transport and supply vessels.⁹⁹

The quote is significant because by pointing out the deviation from the policy of application to fleet needs it implies that supporting those needs is the primary role of contemporary naval aviation.

As a subset of naval aviation, patrol aviation was developed as an auxiliary component to support the “traditional naval approach to battle using a group of battleships as the force of decision.”¹⁰⁰ Patrol aviation was developed to exploit the technological advantages of long-range rigid airships and flying boats to support this traditional fleet-centric approach to naval power projection.

⁹⁸ Ibid., 46-47.

⁹⁹ Warlick, 7.

¹⁰⁰ Kuehn, *Agents of Innovation*, 89.

Lighter-than-air Craft through the End of WW I

In WW I the only aircraft type produced by western navies that could even remotely operate with the extended range, payload, and endurance required to support a sea-based fleet engagement across the Pacific was the lighter-than-air craft (L/A). L/A technology resident in rigid and non-rigid airships. L/A would be a strategic capability that the U.S. Navy would pursue to its limits during the interwar period. However, in the early days of WW I it was the only aircraft technologically capable of covering the kinds of distances and maintaining the endurance necessary to be considered in the fleet-centric strategy required to wage a Pacific war. The following testimony before the General Board by Naval Constructor Westervelt of the Bureau of Construction and repair (BuC&R) on September 12, 1917 highlights the strategic potential for the use of lighter-than-air craft in the Pacific:

For cooperation in the submarine situation on the other side to a very considerable extent, so far as coastal patrol dirigibles are concerned. For our own reconnaissance work from advanced positions like Hawaii or Block Island, I should say very decidedly that the rigid dirigible would be a very valuable instrument. . . . The non-rigid has not the cruising radius and reliability of the rigid it is more suited for coastal patrol.¹⁰¹

Westervelts testimony was derived his participation in a joint Army and Navy Aeronautical Commission to Britain, France, and Italy in the summer of 1917. The purpose of the commission was to “Secure information bearing upon the aeronautical policy in the United States.”¹⁰² The testimony highlights the General Boards interest in the emerging military application of lighter-than-air technology in the Pacific. It is

¹⁰¹ NARA, PHGB, 1917, vol. 1, 253.

¹⁰² Ibid., 240.

significant to note that naval leadership was interested in the application of patrol aviation in the Pacific before the entry of the United States into WW I.

The first embarked aviation on U.S. naval vessels in WW I were kite balloons, which were commonly used for short-range scouting and gunnery spotting.¹⁰³ Kite balloons were replaced by observation aircraft and were completely phased out of service by the early 1930s. Designated ZK, the Z, patterned after the German manufactured zeppelins, signified lighter-than-air, and the K for kite balloon. The Navy procured 117 with ninety-nine being purchased directly from American manufacturers.¹⁰⁴ The significance of the kite balloons lies in their role as fleet-based aviation. That is they operated from the fleet while at sea while all other contemporary aircraft of the time operated from advanced shore bases and operated with the fleet. In today's terminology, they were organic to the fleet. This organic capability would be the driving force behind the interwar development of embarked airpower in support of the Battle Fleet.¹⁰⁵

The General Board discussed kite balloons at length during the Development of Naval Aviation Policy hearings beginning in March 1919. This period of post-war drawdown and reorganization of the fleet was the first definitive step taken by the naval leadership to break the WWI paradigm of the conflict in European waters, and marks the

¹⁰³ NARA, PHGB, 1917, vol. 1, 255.

¹⁰⁴ Gordon Swanborough and Peter M. Bowers, *United States Navy Aircraft since 1911* (Annapolis, MD: Naval Institute Press, 1990), 567.

¹⁰⁵ Continued discussions during the 1919, General Board hearings refined the role of naval aviation. Specifically the difference between embarked aviation and shore based aircraft i.e. heavier-than-air and lighter-than-air patrol aviation.

strategic post-war shift toward a fleet that was preparing for a vastly different conflict in the Pacific.

The first non-rigid airship flown by the U.S. Navy was Designated DN-1 (dirigible, non-rigid-one). It was built by the Connecticut Aircraft Company, New Haven CT and shipped to Pensacola, FL in December of 1916. The first flight hours aboard “Dirigible, Navy, #1” were on 20 April 1917 by Lieutenant Commander Frank R. McCrary one of only two qualified L/A aviators in the U.S. Navy at that time.¹⁰⁶ The B-series non-rigid airships were the first designed and produced by the Navy. From June 1917 to July 1918, the Navy purchased sixteen contracted B series airships from Goodyear and the Connecticut Aircraft Company. The Navy leveraged the established aeronautic infrastructure of Great Britain to produce the design specifications for the B-series airship. This is indicative of how far behind the United States had fallen in aeronautic design when it entered WW I.¹⁰⁷

The C-series airship was designed for coastal ASW patrol and convoy escort. Ten C-series airships were produced from 1918 to 1921. The C-ships were 192 feet in length, forty-two feet in diameter, 181,000 cubic feet envelope, sixty miles per hour max speed, ceiling 8,000 feet, and a maximum endurance of twenty-five hours. At twenty miles per hour, it could extend its endurance to 100 hours.¹⁰⁸

Because the C-series airship began its service life too late for wartime ASW patrols, the Navy utilized the airships for innovative technological and operational

¹⁰⁶ Vaeth, 19.

¹⁰⁷ Swanborough and Bowers, 572.

¹⁰⁸ Ibid., 573.

experiments the merits of which influenced subsequent non-rigid development. On 12 December 1918, Lieutenant George Crompton piloted the C-1 which made the Navy's first successful launch of an Army J-4 aeroplane from a non-rigid airship.¹⁰⁹ A C-series airship successfully executed refueling operations aloft from a surface vessel at sea in February of 1919, and in May of that same year a C-5, flown by Lieutenant Commander Emory W. Coil, piloted a 1,400-mile non-stop flight from New York to Newfoundland. The record flight was the first leg of an attempted transatlantic flight in combination with the NC flight that was simultaneously on its way to Portsmouth, England. Gale-force winds tore the C-ship loose from its moorings in Newfoundland and the aircrew was unable to complete the journey. The engines of the C-5 airship had been modified to burn hydrogen, augmented from the envelope, as well as gasoline to improve the range for the long flight. The loss was indicative of an inherent weakness of L/A aviation. Finally, on 1 December 1921 the C-series non-rigid became the first airship to replace its envelope with helium gas justifying the U.S. change of policy to an all helium fleet.¹¹⁰ In 1921, the Navy relinquished control of the non-rigid airships for coastal patrol to the Army while it pursued the long-range scouting potential resident in the rigid airship. In total, the U.S. Navy non-rigids logged over 13,600 hours performing coastal patrol and convoy escort duties during WW I.¹¹¹

¹⁰⁹ Vaeth, 19.

¹¹⁰ Swanborough and Bowers, 572-573.

¹¹¹ Vaeth, 4.

Post-war Drawdown and the Beginning of a Strategic Shift toward the Pacific

To understand the strategic necessity of patrol aviation it is imperative to identify the early goals of the leadership concerning long-range reconnaissance along with how the concept evolved with respect to the innovation of an embryonic technological capability.

The armistice in November of 1918 prompted a post-war drawdown of U.S. naval forces. The U.S. Fleet returned to Hampton Roads, VA for overhaul starting in the fall of 1918. The Navy reorganized its force from the U.S. Fleet to the Atlantic and Pacific Fleets. By 6 August 1919, the Pacific Fleet arrived in San Diego, CA by way of the Panama Canal.¹¹² The organizational skeleton of the Pacific Fleet was faced with the multiple challenges of a post-war drawdown in manpower and funding as well as being in poor material condition after almost two years of combat cruising in the North Atlantic. It was from this point of minimal manning and marginal material readiness, and tactics from naval war limited by Atlantic geography that formed the organizational bedrock from which the strategic foundation of a Pacific Fleet would evolve. Lieutenant R. D. Kirkpatrick of the Bureau of Navigation (BuNAV) addressed the General Board on the “Best method to secure and retain personnel” displays the drastic manpower changes that influenced the post war force structure:

When the U.S. entered the war in April 1917 the Navy had 38 qualified pilots and 163 enlisted aviation mechanics. 19 months later when the armistice with

¹¹² Annual Reports of the Pacific Fleet (PACFLT), 1919, 5, National Archives and Records Administration, General Records of the Department of the Navy, Record Group 80, *Archival Information Annual Reports of the Fleet and Task Forces of the United States Navy 1920-1941*, Combined Arms Research Library, Fort Leavenworth, KS, Microfilm. Hereafter referred to as NARA, Annual Reports.

Germany was signed there were 3005 Officers and 35,667 enlisted men on aviation duty. Only 85 officers and 500 enlisted men were from the regular Navy. The rest were reservists. By April 1919 there remained 1000 officers and 5000 enlisted men of whom 45 are qualified pilots in the regular Navy.¹¹³

The challenging state of affairs that marked this point of developmental origin was also captured in the remarks from the Annual Report of Admiral Hugh Rodman, the Commander in Chief, Pacific Fleet in 1919:

As will be noted, only a skeleton of the Fleet performed active service and carried out Gunnery and Engineering program during the Gunnery year (FY) 1920. This may be attributed to the general run-down condition of the vessels when the Fleet was organized, the lack of facilities in the Pacific for caring for a large number of vessels, and to the personnel situation. All of these conditions were aggravated by the many unforeseen obstacles to be expected with the establishing of a new base. Such as lack of proper coordination between forces afloat and ashore, and the fact that the homes and families of the majority of the personnel were on the east coast, which caused discontent resulting in a constant stream of requests for release or transfer to the Atlantic passing through the office of the Commander in Chief, and in many valuable men failing to re-enlist in the Pacific.¹¹⁴

It is clear that initially the significant manpower, infrastructure, and basing challenges plagued the homeport change of the new fleet and were a significant barrier to the development of operational development. However, the prioritization of the strategic shift to the Pacific served to focus post-war fleet development.

While the post-war reorganization of the fleet signified a strategic shift toward potential conflict in the Pacific, the force laydown suggests that the prioritization of strategic capability was still in the process of re-focusing from its efforts during the past

¹¹³ Lieutenant R. D. Kirkpatrick's (BuNAV) address to the board on the "Best method to secure and retain personnel." Aviation Policy: Material and Personnel, 28 April 1919, NARA, PHGB, 1919, vol. 3, 788.

¹¹⁴ Reports of the PACFLT, 1919, 5, Annual Report of the Commander in Chief, Pacific Fleet to Commander in Chief U.S. for the calendar year 1919-1920, in NARA, Annual Reports.

nineteen months operating in the North Atlantic. By October of 1919, The Pacific Fleet Air Detachment, commanded by Commander Henry C. Mustin, was composed of a Seaplane Squadron, a Ship-plane Squadron, and a Kite Balloon Squadron.¹¹⁵

The five NAF F-5-Ls for the Seaplane Squadron were organized into one division with a complement of fifty personnel. The enlisted were assigned as crews to each plane and the pilots were given collateral duties as Engineer Officer, Radio Officer, Gunnery Officer, Construction and Repair Officer, and the Officer in Charge of Surface Craft. The USS *Aroostook* was temporarily assigned to the Air Detachment to perform duties as flagship and tender.¹¹⁶ Squadron operations consisted of fleet utility work and, with the exception of an expeditionary cruise to San Pedro to support the surface fleet in gunnery exercises, showed little progress toward the creation of a patrol and reconnaissance capability that could support the fleet in a campaign across the western Pacific. As the report highlights:

Operations during the year consisted of “establishing and effectively maintain daily passenger and mail service between San Pedro and San Diego assisted the Commander in Chief in carrying on a considerable portion of the administrative work of the fleet. . . . The Pacific Air detachment also performed rescue, photographic, torpedo recovery and spotting duties during gunnery exercises with battleships and destroyers.

In April 1920 the seaplane squadron moved on board the U.S.S. *Aroostook*, which had been fitted with out with store rooms, a gas tank and berthing for officers and enlisted men. The squadron then transferred to San Pedro to test the mobility of the unit. The aircraft dropped Parachute flares over the ships of Battleship division eight to show the effect of illumination by aircraft. . . . The largest operations of the Seaplane Squadron was 12 June 1920, when destroyers force exercised with the battleships force and made 32 torpedo attacks. The seaplane

¹¹⁵ Annual Report of Air Detachment, PACFLT, for the period of 1 July 1919, to 30 June, 1920, 61 in NARA, Annual Reports.

¹¹⁶ *Ibid.*, 75.

Squadron scouted for the destroyers and found them 19 miles from the battleships.¹¹⁷

By the end of June, the Seaplane Squadron expanded to twelve F-5-Ls, with 133 enlisted men and eighteen officers. These meager operational beginnings showed the attempted paradigm shift from WW I strategy of coastal ASW patrol and convoy escort to the role of reconnaissance in support of the battle line tactics for fleet engagements. It also opened the aperture for the versatility of the flying boat for fleet utility, for example, mail carrying, torpedo recovery, and experimental work with communications and flares. This innovative demonstration of what the aircraft could actually do for the fleet was directly in line with initial post war policy direction that naval leadership wished to go with naval aviation and the fleet as a whole.¹¹⁸

However, the operations of the fledgling Pacific Fleet Air Detachment at San Pedro show a distinct contrast in training resources and strategic priority given to the Atlantic Fleet maneuvers at Guantanamo Bay, Cuba in the winter of 1919. The report of the Atlantic Fleet Air Detachment commanded by Captain George W. Steele, Jr. was read and discussed before a General Board hearing on 12 May 1919. The small but significant achievement foreshadowed the complex annual Fleet Problems and concentrations that annually exercised tactical ideas from the NWC along with warplan scenarios provided by the Op12:

The small detachment of H-16s has met successfully every situation which it was included they have scouted all the sea area between Guantanamo Bay and the

¹¹⁷ Annual Report of Air Detachment, PACFLT, for the period of 1 July 1919, to 30 June, 1920, 61-76, NARA, Annual Reports.

¹¹⁸ Development of Naval Aviation, 27 March 1919, NARA, PHGB, 1919, vol. 1, 364-366.

islands of Haiti and Jamaica. On 18 March, four H-16s left Guantanamo Bay, engaged in a scouting flight and landed in Port Au Prince. They few thence to Kingston, Jamaica, on the 21st and from that port returned to Guantanamo Bay on the 25th. On the 28th, these four same airboats held bombing practice off Guantanamo Bay each dropping two 170-pound depth bombs on a towed target. The above facts are cited to illustrate the use which has been made of these comparatively small airboats. In comparison with some of the older seaplanes, the H-16 is immense and its capabilities are proportionately greater. But the end is not in sight. Already the NC plane is in commission and it is much larger than our H-16s and its endurance is 15 hrs. compared to our 5.5 hrs.¹¹⁹

The Air Detachment commanded by Captain Steele was sustained by the converted minelayer, USS *Shawmut*. The significance of the detachment was that the operational innovation to sustain a small contingent of seaplanes from a mothership and use the surrounding islands of Haiti and Jamaica to layover between scouting sorties was the model that broke patrol aviation out of the mold formed from coastal patrol in the north Atlantic in WW I.

It seems that Captain Steele had the foresight to understand the gravity of his success. His report continues:

So many of our ideas of naval policy have been gained from the British that any discussion of the subject must consider their methods. The British idea of fleet aviation is to employ fast planes with limited radius, and to transport them to the scene of action by combatant ships or specially built airplane carriers. In this practice they lead the world, and in all development of sea power hitherto, the example of Great Britain has been worthy of careful consideration. It does not follow that the British aviation program, developed in haste to meet a particular situation, which does not match our probable future war operations, and is limited by the present development of aircraft construction. is a safe or a wise lead to follow. . . . There are tremendous possibilities in fleet aviation not met by the British. Those possibilities are presented by large airboats or seaplanes, craft the like of which there are none in the world today. But from the progress already made it is not impossible to conceive of an airboat of sufficient endurance to fly across the Atlantic and return.

¹¹⁹ Captain George W. Steele, C.O. of USS *Shawmut*, report to Commander in Chief, Atlantic Fleet, NARA, PHGB, 1919, vol. 3, 913-914.

Steele's remarks are paradigmatically significant because they were presented in the innovatively open forum of the General Board where operational experience and strategic foresight could be imparted to the most senior leadership in the Navy. It was precisely moments like this that forged the future course of patrol aviation as it developed through the interwar period.

Along with modeling the potential operational framework for sea-based patrol aviation in support of the Battle Fleet, the maneuvers from Guantanamo Bay in the winter of 1919 provided improvised solutions to the tactical problem of scouting for the fleet at sea. The exercise also brought to light the handicaps of the makeshift tender *Shawmut*. Built as a mine-laying vessel she had limited berthing, speed, and space for aviation maintenance shops. These drawbacks characterized the majority of the converted vessels assigned as seaplane tenders and would plague the interwar development of an operational proof of concept for the flying boats through the entire interwar period.

However groundbreaking this achievement might have been in retrospect, the operational combination of seaplane and mother ship was given low developmental priority during the early years of post-WW I naval reconstruction. This further illustrates that though the signs of a prioritization shift in strategic paradigm were starting to materialize in support of War Plan Orange, the factors molding post-WW I fleet development still focused on the Atlantic Fleet.

The Navy was in the process of assessing its strategic capability in an attempt to guide its course of development that suited its strategic goals. This assessment process opened up an aperture for the institutional leadership to see the versatility of the flying boat from fleet utility such as mail carrying, torpedo recovery, and experimental work

with communications and flares, to operational innovation of sea-based scouting with aircraft tenders. This developmental period was dedicated to exploring what the aircraft could actually do for the fleet. The operational reports from the Air Detachments of both the Atlantic and Pacific Fleets were indicative of the initial post-war policy that naval leadership wished to guide naval aviation and the fleet.¹²⁰

1919 and the Foundation of Naval Aviation Policy

The General Board held a series of hearings from March to May 1919. These discussions were focused on defining the role of naval aviation in order to determine policy that supported the reorganization of the U.S. Fleet. Naval leadership spent the spring of 1919 deciding on the correct way to expand it into an integral strategic and operational component of the fleet.

The General Board members started from a baseline policy of “what lines aviation should be developed, types of aircraft considered necessary for the Navy and general characteristics of each type.”¹²¹ The hearings concluded with distinct short-term (March to July 1919), near-term (1919 to 1920), and long-term (1920 to 1925) priorities with which to proceed. Prioritization was divided along the heavier-than-air/lighter-than-air boundary. The discussions agreed on a basic force to accompany the fleet at sea. This included the fighting plane, the reconnaissance and spotting plane, and the torpedo and bombing plane along with development of the rigid dirigible for long distance scouting. The large land-based seaplane and the smaller dirigibles of the non-rigid construction

¹²⁰ Development of Naval Aviation Policy, 27 March 1919, NARA, PHGB, 1919, vol. 1, 364-366.

¹²¹ Ibid., 364.

were to be developed for coastal patrol and convoy escort.¹²² Commander John H. Towers of the BuC&R testified before the General Board in March 1919 on what lines aviation should be developed. Towers was naval aviator number four, meaning the fourth naval officer to become a naval pilot. He testified with authority on matters of naval aviation and eventually was detailed to the BuAer after its creation in 1921.¹²³

Naval aviation should be developed for offensive and defensive work with the fleet. considering for offensive work the development of aircraft used in connection with the fire control of shells, offensive scouting, and the for the use as direct offensive weapons carrying torpedoes and bombs. Along defensive lines, development of A/C [aircraft] to prevent scouting of hostile Aircraft and to prevent hostile attack on capital ships. . . . As applying to 1919-1920, 1920-1925 would be that some of the development for the first period will be for the purpose of working out the use of aircraft rather than developing the aircraft themselves. In other words, I think we should very rapidly push the development of aircraft from ships in connection with scouting and spotting.¹²⁴

The comments reflect the recommendation by the General Board to preserve an economy of effort by encouraging the use of existing aircraft for developing their potential role. In this case, the launching of short-range scout planes from capital ships.

The most urgent needs for the first of the three developmental periods (March to July 1919) were “prioritization of developmental program for fleet airplanes, airplane carrier, and fleet bases are the three most important issues for action.”¹²⁵ The recognition of the need to build the current infrastructure and develop the strategic role of aviation

¹²² Development of Naval Aviation Policy, 27 March 1919, NARA, PHGB, 1919, vol. 1, 364-365.

¹²³ Clark G. Reynolds, *Military Affairs* 52, no. 2 (April 1988): 78-84. John H. Towers, the Morrow Board, and the Reform of the Navy's Aviation.

¹²⁴ Development of Naval Aviation Policy, 27 March 1919, NARA, PHGB, 1919, vol. 1, 365.

¹²⁵ *Ibid.*, 367. CDR Whiting,

into the five-year program was the first area to be prioritized and resourced with the funding remaining in that fiscal year.

Commander John Towers of the BuC&R testified about the second stage of the three-stage program (1920 to 1921):

Lay down a regular rigid airship construction program . . . there should be included along with it a construction of so-called air-ship dockyards. . . . The very existence of the rigids as a competitor for the light cruiser and in its own field depends upon being able to build them so that they are more or less self-sustaining. There should also include into next year's program, the building of what may be called an experimental production schedule for the three types of aircraft working with the fleet. Namely spotting, reconnaissance, and the weight carrier (torpedo/bombing). There should also be included, the construction of a sufficient number of large seaplanes to carry on seaplane development. I mean the additional seaplanes of the NC type as might be brought out next year. We do not know yet to what point the development of seaplanes will reach and it is within the bounds of possibility that if they will keep on going at the rate they have been going on that last few years, that they also will be a self-sustaining craft. Development should carry on until we are definitely sure we have reached a maximum. . . . The construction is justified for use in connection with the defensive patrol of the Atlantic seaboard. Depending on cruising radius, continued development would be justified for such uses with the idea that eventually they will be able to connect up with the fleets for reasonable distances.¹²⁶

The priorities for the six-year plan (1919 to 1925) included the production of ship-planes for use on the already approved aircraft carrier, also a significant investment into the capability of long-range scouting. Commander Towers also testified on the subject of long-term developmental priorities:

There are two things that I think are obvious methods of procedure. First is the continued development of the rigid. I think you are perfectly safe to lay down a six-year program. The type may change entirely but it's absolutely safe to depend upon their usefulness. Second, the development of the big seaplane will be continued throughout this period. It is impossible to predict the size it will reach

¹²⁶ Development of Naval Aviation Policy, 27 March 1919, NARA, PHGB, 1919, vol. 1, 369, CDR Towers on the three-phase development program.

by the 1925 and it will be impossible to predict how many you will need because it will depend on how useful they are. They are going up at a very rapid rate.¹²⁷

The discussion after Towers' testimony of the three-phase developmental program for naval aviation turned to the strategic priorities of Congress and the appropriation to expand the infrastructure of fleet aviation bases on the Atlantic and Pacific coasts.

The following discussion between Admiral Winterhalter, serving as the senior member of the General Board and Commander Towers on the subject of the strategic priorities concerning patrol aviation, highlights the idea that shore based patrol aviation was being developed with the strategic focus reserved for patrol along the Atlantic coast:

ADM Winterhalter: We have here the plan for patrol and protection of the Atlantic and gulf coasts. It seems to me, as far as patrol is concerned, you have your work cut out for you for 1919-1925.

CDR Towers: you mean the development of this?

ADM Winterhalter: As you know, there is another plan for the Pacific Island possessions.

CDR Towers: I have recommended this so many times, I have forgotten that it hadn't been approved.

ADM Winterhalter: It has not been approved in its entirety but the Atlantic coastal patrol has been approved in principle.

CDR Towers: It is to a great extent completed.

ADM Winterhalter: Yes, and no. You will not get all the stations that are projected. They were limited by Congress to five on the Atlantic coast and one on the Pacific, making six in all.¹²⁸

With the exception of the rigid airships, the strategic capability of patrol aviation in the form of shore-based flying boats for coastal patrol was established by the events of

¹²⁷ Development of Naval Aviation Policy, 27 March 1919, NARA, PHGB, 1919, vol. 1, 369-371.

¹²⁸ Ibid., 371-372.

WW I. There were also a significant war surplus of flying boat spare parts and engines at the NAF in Philadelphia. This allowed for the maintenance of the post-war force of H-16/F-5-Ls without dipping into current fiscal appropriations that were prioritized for the production of embarked aviation (ship planes and rigid airship technology). This is evident when one looks at how long the Navy kept the WW I generation of seaplanes in service (1928 in the case of the H-16/F-5-L). The prioritization for technological development of embarked aviation with the fleet overshadowed the advance of shore based patrol aviation. However, the General Board hearings and the operational feedback from the annual reports of fleet commanders created a productive forum on how to best develop technological capabilities. This forum helped define the strategic balance between capabilities of patrol aviation based at sea and on shore.

General Board hearings in March of 1919 on the state of aircraft engine development highlight the strategic distinction between ship-based aircraft and coastal patrol aircraft. Ship-based aircraft were envisioned as operating from the fleet in the form of carrier-based aircraft and observation planes catapulted from capital ships. The design specifications were modeled from the capabilities of Great Britain's carrier based aircraft.¹²⁹ They were typically single piloted aircraft with a four-hour, 200-mile radius of action powered by 130 to 300-horsepower Liberty engines. Coastal patrol aircraft had already been realized in the F-5-L/H-16 for coastal patrol; two Liberty-12A of 800 horsepower giving them 500 plus mile radius of action. The longest-range heavier-than-air flights of 1,200 plus miles had been proven by the NC type seaplane requiring three Liberty-12A totaling 1,200 horsepower. The only shore-based aircraft envisioned for

¹²⁹ Naval Aviation Policy, 28 March 1919, NARA, PHGB, 1919, vol. 1, 418.

long-range fleet work was the rigid airship, which, by contrast had a 5,200-mile radius of action and could remain airborne for several days.¹³⁰

The Bureau of Steam Engineering (BuSE) was responsible for engine development in naval aircraft prior to the creation of BuAer in 1921. There was an ongoing effort to develop an air-cooled engine that could overcome the low power to weight ratio in the current water-cooled aircraft engines. This low ratio was a hindrance to the endurance and range capability of the Liberty engines that powered flying boats and dirigibles.¹³¹

BuSE was also testing and developing the possibility of a steam powered engine for use in naval aviation to improve range and endurance of long-range patrol aircraft. Commander A. K. Atkins of Bu S&E provided the current state of the steam engine development to the General Board in the 28 March hearings:

In 1918, the Navy allotted \$50,000 to develop a steam plant for one of the H-16 type flying boats. What is known as the Committee on Experimental Power, with its headquarters in NY has assembled all the talent available in the country for the purpose. The power plant is approximately 800 hp with one boiler and two turbines, the idea was to determine whether a steam power plant could be built that would fit into one of our present types of boats rather than build something for which we would have to build a special machine. Early indications are that there is no great improvement over gasoline motors but I think there is considerable development possible for such a plant. Boiler in the hull of a seaplane, turbines above, noise reduction and reduced head resistance (drag coefficient). 1400 rpm would be an increase in the efficiency of the current liberty-12A, which runs at 1700 rpm. They would even work for powering the new rigid airships as they normally carry water for ballast that could be used in the boiler as well.¹³²

¹³⁰ Aviation Policy: Lighter Than Air, 14 April 1919, NARA, PHGB, 1919, vol. 2, 615.

¹³¹ Naval Aviation Policy, 28 March 1919, NARA, PHGB, 1919, vol. 1, 397-409.

¹³² *Ibid.*, 409.

This testimony offers a glimpse into the full spectrum of innovation that was pursued by naval leadership. The General Board sought out the contemporary experts in their respective technical fields to leverage industrial experience and gauge the realism of possible solutions like the steam turbines.

Even more spectacular was the discussion about the possibility of electric drive motors for rigid airships. The use of helium to replace hydrogen was still two years from becoming a reality, but the theoretical safety benefits opened the possibility of putting electric engines within the 2,000,000 cubic feet envelope of a rigid airship. The enormous airship could use static electricity generated naturally by the friction of the aircraft through the air to act as a power source for the electric current necessary to drive the propeller motors.¹³³

The development of aircraft power plants served to drive the operational distinction between embarked fleet aviation and shore-based coastal patrol aircraft. This distinction, based on technological limitations of contemporary power plant design and radius of action placed the rigid airship at the forefront of the capabilities race that drove development in the early half of the 1920s. Though the Navy did pursue the parallel development of the F-5-L “for range and payload, working up to maximum radius for the ultimate idea of developing a self-sustaining unit to operate with and accompany the fleet.”¹³⁴ The Testimony of Captain Earnest J. King on Naval aviation policy development in May of 1919 makes the distinction between the traditional fleet-centric

¹³³ Naval Aviation Policy, 28 March 1919, NARA, PHGB, 1919, vol. 1, 409.

¹³⁴ Future Naval Aviation Policy, 2 April 1919, NARA, PHGB, 1919, vol. 1, 463-464.

auxiliary role of aviation in support of the battle line and the WW I coastal patrol capability that aviation was evolving away from in order to sortie with the fleet:

What are you developing aircraft for if not for the Fleet? The only other thing being what might well be called the “Coastal Service.” If they want to draw the line between the Fleet and the Coastal Service that’s one thing, but as for the whole air service itself, there should not be anything in it other than naval activities where the arrangements can be made to have it ready to cooperate with the Fleet.¹³⁵

This distinction between coastal patrol and fleet aviation was drawn by the ability to embark ship-based aviation with the fleet.

The development of the aircraft carrier was the epicenter of this revolutionary technological and operational capability. However, in 1919 the collier *Jupiter* had yet to be converted into the USS *Langley*. In the spirit of utility, and in an attempt to maximize shore-based aviation with the fleet, the USS *Shawmut* was utilized as a seaplane tender for four H-16s operating from Guantanamo Bay, Cuba. Captain Noble E. Irwin, Director of Naval Aviation under the OpNav and Lieutenant Commander Albert C. Read, Commanding Officer of the seaplane tender, *Shawmut* testified before the General Board in April of 1919. Their discussion before the General Board on highlights the application of the “mother ship” concept, utilized by submarines and destroyers, to operational fleet aviation:

LCDR Read: Mother ships should be provided until the carriers are available to act as floating repair and supply bases. These would do the major repair work on of planes on battleships. The battleships would be expected to do the routine overhaul work and any small work such as renewing wires, putting a patch on the fabric etc. The bulk of the large work would not be expected to be done on battleships. . . . She (the *Shawmut*) is too small, but the idea has worked out very well. Of course, the *Shawmut* has, at present, the large H-16s twin

¹³⁵ Naval Aviation Policy: Fleet Aviation, 15 May 1919, NARA, PHGB, 1919, vol. 3, 960.

Liberty craft operating with the fleet, and she is a necessity for keeping those going.

CAPT Irwin: As I understand it, Read, you are making a distinction there—a temporary expedient—between the airplane carrier and the mother ship, which is to be used temporarily until we acquire an airplane carrier; the mother ship acting for heavier-than-air and lighter-than-air practically the same as a mother ship does for submarines.¹³⁶

The testimony draws attention to the use of seaplane tenders to support patrol aviation acting as floating repair and supply bases. This concept of operation was seen as a temporary expedient to be used until the aircraft carrier came online.

The post-war study of German successes with zeppelins in the North Sea, specifically at the Battle of Jutland, highlighted range, endurance, and payload as the three necessary qualities for determining the ability of patrol aviation to support fleet engagements.¹³⁷ The obvious advantage in favor of the zeppelins over fixed-wing aircraft, qualified the rigid as the primary candidate for long-range fleet reconnaissance and scouting.¹³⁸ In February of 1919, Admiral William S. Sims, Commander U.S. Naval Forces in Europe, cabled the Secretary of the Navy with a memorandum urging the importance of a U.S. construction program to build a fleet of rigid airships. The argument was based on the German tactical successes with their fleet of zeppelins in WW I. Rigid airships for long-range scouting were seen as the as the ultimate answer to the problem of radius of action. This led the United States down a path of lighter-than-air development

¹³⁶ Future Naval Aviation Policy, 2 April 1919, NARA, PHGB, 1919, vol. 1, 477-478. Captain Irwin was the Director of Naval Aviation until May 1919, when he was succeeded by Captain Thomas T. Craven.

¹³⁷ Naval Aviation Policy: Lighter-Than-Air, 21 April 1919, NARA, PHGB, 1919, vol. 3, 733-740, 953

¹³⁸ NARA, PHGB, 1919, vol. 2, 659.

toward a strategic capability that, according to Admiral Jellicoe of Great Britain, “served to change the natural balance of power whereas a weaker force could out maneuver a stronger force with the advantage of information. Naval warfare would no longer just be decided by naval gunnery and armor plate.”¹³⁹

The development of a lighter-than-air program required a completely new infrastructure that had to be built from the ground up. This infrastructure included personnel, training, basing, hangars, gas plants for hydrogen (and eventually helium), assembly, construction, and overhaul. The 1919 Naval Appropriations Act of Congress provided for two Navy rigid airships and one lighter-than-air station to be built in Lakehurst, New Jersey.¹⁴⁰ The program would begin with the purchase of an R-38 (renamed ZR-2) type rigid airship from Britain. The plan to build another rigid (designated ZR-1, and named *Shenandoah*) in the United States leveraging Goodyear in Akron OH, and NAF for the construction.¹⁴¹ The six-year program was designed to produce two airships per year until ten were built. This included the building and manning of ten bases with one in Hawaii and the Philippines.¹⁴² Unfortunately the plans for the acquisition of the R-38/ZR-2 was cut short when it crashed during the acceptance

¹³⁹ Memorandum from Admiral Sims to Secretary of the Navy, NARA, PHGB, 1919, vol. 3, 736-740.

¹⁴⁰ Vaeth, 22.

¹⁴¹ Naval Aviation Policy for Lighter-Than-Air, NARA, PHGB, 1919, vol. 2, 672-680.

¹⁴² Naval Aviation Policy: Lighter-Than-Air, 29 April 1919, NARA, PHGB, 1919, vol. 3, 743-750.

flight over England on 24 August 1921 killing sixteen U.S. Navy and twenty-four British aviators.¹⁴³

The operational pursuit of self-sustaining rigids with the fleet met with obstacles of material difficulty. The infrastructure requirement for hangars and mooring stations all over the globe and larger manpower requirements needed to sustain/maintain and operate (around 1,000 men per station), were difficulties that the leadership never solved for rigid airship operations.¹⁴⁴

What defined this early phase of the developmental program (1919 to 1920) was the concept of using what was already on hand to develop a working model that could be expanded upon once the technological and operational limits had been reached. In this way, the possibility of technological innovation was allowed to drive the strategic capability. It was not until 1922 that the industrial infrastructure and centralized administrated bureaucracy were influenced by the strategic limitations imposed upon the Navy by the Washington Naval Treaty that strategy began driving the innovation of long-range patrol in support of the fleet.

This early period of interwar fleet aviation was characterized by open-ended innovation and technological possibility. The developmental program of the rigid airship that culminated in the production of the *Shenandoah*, the *Akron* and the *Macon* required innovative contemporary technology. Where new technology was yet unavailable, operational innovation of patrol aviation with the H-16/F-5-L seaplanes and their

¹⁴³ Vaeth, 22-23.

¹⁴⁴ Naval Aviation Policy: Lighter-Than-Air, 29 April 1919, NARA, PHGB, 1919, vol. 3, 703.

requisite mother ship tenders was developed with undermanned, post-war, surplus equipment. Development of patrol aviation was driven by the shift in the strategic paradigm of WW I from the Atlantic to the Pacific. However, growth through the remainder of the 1920s was shaped by a different set of variables. The restrictions of treaty system, bureaucratic centralization, and incremental technological advances challenged the ability of naval leadership to continually innovate along strategic and operational lines with respect to a viable long-range patrol capability to support the Battle Fleet in the Pacific.

CHAPTER 4

1922 to 1931: BUILDING THE FUTURE

From 1919 until the Washington Naval Conference in November 1921, the strategic and technological priorities of naval leadership were shaped by the necessities of the post-WW I draw down and the operational reorganization of the fleet. Naval leadership spent the majority of the 1920s reconciling these two priorities against the restrictive backdrop of international disarmament and arms limitation.

1922 to 1931 marks the period where much of the policy and strategy that naval leadership agreed upon in the post-WW I drawdown period was re-shaped to accommodate the restrictions of the treaty system. The nine-year period between the 1922 Washington Naval Treaty and the 1930 London Naval Treaty was characterized by both feast and famine for the development of patrol aviation. The aging fleet of flying boats had slipped into obsolescence while the rigid airship construction program was still at the grass roots level of production. The limitations of the treaty system, the centralization of U.S. naval policy toward aviation in the form of the BuAer, and the continued operational reorganization of the U.S. Fleet became the primary determinants that fostered patrol aviation development from 1922 to 1931.

Both lighter-than-air and heavier-than-air components of the fleet's long-range scouting arm evolved through a period that was shaped by three powerful influences. The first influence that shaped the development of patrol aviation through the period was the outside powers party to the limitation treaties themselves. The restrictions of the treaty

system reshaped the U.S. naval strategy and re-prioritized the pursuit of long-range patrol aircraft.¹⁴⁵

The second influence on the development of patrol aviation for this period was the centralization of the administrative bureaucracy as it pertained to aviation. Using the NAF in Philadelphia as a research and development facility, BuAer was able to control and manage the technological expansion and operational integration of naval aviation. BuAer was the fulcrum that balanced the development and procurement of the second-generation flying boats and rigid airships in the 1920s by liaising between civilian aircraft manufacturers and the federal government.¹⁴⁶ The Lampert Committee and the Morrow Board served as a forum for discourse and stimulated congressional appropriations in 1926 that provided for a five-year build program for naval aviation.¹⁴⁷ This five-year build program kept the civilian aircraft industry alive and set the conditions for the transition of the research and development phases of aircraft design from the NAF to the private firms once they began to prosper.¹⁴⁸ This paved the way for a revised procurement program after 1931 and eventually led to the construction of the third generation of flying boat, the Consolidated PBY Catalina.

The third factor that influenced development was the continued strategic and operational integration of patrol aviation in the fleet. In order to build a navy that could achieve sea control over the vastness of the Pacific Ocean, naval leadership had to

¹⁴⁵ Kuehn, *Agents of Innovation*, 1.

¹⁴⁶ Trimble, *Wings For the Navy*, 69-72.

¹⁴⁷ *Ibid.*, 75.

¹⁴⁸ *Ibid.*, 75-80.

reconcile the rapidly changing technological capabilities of aviation in support of national strategy that was both expeditionary and self-supporting. Patrol aviation maintained an uphill climb throughout the 1920s with respect to the aircraft themselves as well as the support of the tenders, which gave them operational sustainability.

The Treaty System

The impetus provided by the restrictions of the naval arms limitation treaties of Washington (1922) and London (1930) is an important distinction that marked the evolution of interwar strategic development for the U.S. Navy as a whole and patrol aviation in general.¹⁴⁹ Edward S. Miller's study of War Plan Orange recognizes the influence that the Washington Naval Treaty had on the overall strategy of War Plan Orange. Miller illustrates the effect of the treaty by highlighting the Cautionaries final victory over the Thrusters. Miller proposes that the strategic clarity of a future conflict in the Pacific led to a unity of effort that served as an impetus to innovation.¹⁵⁰

John T. Kuehn's *Agents of Innovation* (2008) examines the influence of the Fortification Clause (Article XIX) on interwar innovation. Kuehn identifies the 1922 Washington Naval Treaty, particularly the prohibition of forward basing in Article XIX, as the "root cause which channeled innovation in the interwar Navy."¹⁵¹ Kuehn acknowledges the innovation of contemporary interwar naval leadership and its ability to

¹⁴⁹ Miller, "Eyes of the Fleet," 33-34.

¹⁵⁰ Ibid.

¹⁵¹ Kuehn, *Agents of Innovation*, 1-2.

circumvent the treaty system with technological and operational solutions to the strategic problem of forward basing.¹⁵²

Both scholars assert the influence of the treaty system on the interwar creation of a navy capable of fulfilling the strategic need for a modern power projection fleet that was sea-based, and self-sustaining.¹⁵³ The development of naval aviation was at the forefront of this effort. It is in this light of designing a force around a particular conflict that patrol aviation is developed in the interwar period.

1922 Washington Naval Arms Limitation Conference

In March 1922 (thirty-five days after the treaty was signed) The General Board held hearings in order to submit “recommendations along the lines of a naval policy under the restrictions imposed by the recent conference, which reduces our building program and makes it necessary to maintain efficiency during a period of peace.”¹⁵⁴ The General Board hearings for 1922 prioritized the strategic need for aviation development toward self-sustained operations with the fleet. The strategic capability of long-range patrol aircraft based with the fleet was pursued with renewed priority.¹⁵⁵

The setbacks in rigid airship procurement due to the loss of the ZR-2 over England and the bulk of experienced U.S. Navy lighter-than-air leadership gave BuAer the opportunity to testify on behalf of long-range flying boat development before the

¹⁵² Kuehn, *Agents of Innovation*, 3-5.

¹⁵³ Ibid.

¹⁵⁴ Naval Air Policy, 3 March 1922, NARA, PHGB, 1922, vol. 1, 26.

¹⁵⁵ Miller, *War Plan Orange*, 175.

General Board in March 1922.¹⁵⁶ The sinking of the *Ostfreisland* in July of 1921 yielded significant tactical lessons for patrol aviation. In addition, the continued operational success with the concept of flying boat and mother ship tender, demonstrated in Guantanamo Bay, Cuba, was now being perfected in smaller detachments from both coasts. These operational and tactical successes allowed for discussions of patrol aviation's expeditionary role in support of the fleet. The testimony refines the potential operational development of patrol aviation by the General Boards formal recommendation to increase the number of seaplane tenders to support seaplane squadrons from the west coast.¹⁵⁷ Captain Henry Mustin, Commander of the Pacific Fleet Air Squadrons, was referring to the BuAer coordinated design of the PN-series flying boat that had a radius of 1,310 miles:¹⁵⁸

Captain Schofield: The next item mentioned by Aeronautics is as follows:

(b) The item one aircraft tender in each fleet is inadequate and that this item should be changed to read 'five seaplane tenders and one lighter-than-air tender'. This number of seaplane tenders can handle five squadrons of seaplanes . . . it is the bureau's opinion that at least five of these seaplane squadrons should be immediately available in the Pacific in the event of war. It is believed that one lighter-than-air tender will be sufficient to accommodate personnel and facilities for a rigid dirigible advance base detail.

Captain Mustin: The bureau has been working on the design of seaplane to go with these tenders that has a radius enabling her to go from San Diego to Honolulu. From any point beyond Honolulu, with a half load of fuel and bombs, and have a radius of 1,000-1,200 miles. . . . That is she could safely be sent on a 500 mile raid.

¹⁵⁶ Vaeth, 22-23.

¹⁵⁷ Naval Air Policy, 3 March 1922, NARA, PHGB, 1922, vol. 1, 47-50.

¹⁵⁸ E. R. Johnson, *American Flying Boats and Amphibious Aircraft*, 63.

Mustin's testimony proceeds to justify the number of requisite tenders as they apply to a campaign of securing advanced bases across the Pacific from Honolulu to the Marshall and Caroline Islands:¹⁵⁹

There would be a need for one tender to occupy the furthest advanced base and the others to complete the lines of communications. . . . The tenders providing the necessary bases for forming a flying route across the Pacific. Then when we get the war production, we can increase the number of bombing seaplanes in the Pacific and have a continuous supply of bombers to the islands . . . the continuous supply of bombers could be carried out without calling on any surface supply ships to transport aviation material.¹⁶⁰

While the 1922 General Board hearings testified to the strategic potential of patrol aviation in an expeditionary capacity, the BuAer recommendations to the board called for a "limit on rigid air ship construction to until these have demonstrated their usefulness and value by reliable service."¹⁶¹ Though the construction for ZR-1 (lighter-than-air-rigid-airship-one) (later named *Shenandoah*) had begun in mid-1921, the operational restrictions imposed by the need for significant support infrastructure, maintenance, handling, and training proved to be extensive.¹⁶² This did not dissuade BuAer from continuing to exploit the exponential advantage in range and endurance that the lighter-than-air craft had over its fixed wing cousins.

The General Board hearings following the 1922 Washington Naval Treaty completely refocused their priorities for patrol aviation on realistic strategic capabilities for an expeditionary campaign across the Pacific. In the early years of 1922 the aging H-

¹⁵⁹ Naval Air Policy, 3 March 1922, NARA, PHGB, 1922, vol. 1, 49.

¹⁶⁰ *Ibid.*, 50.

¹⁶¹ *Ibid.*

¹⁶² Warlick, 44-45.

16/F-5-L flying boat with its requisite tender, was an operational reality. The Washington Naval Treaty limitations did not afford the luxury of potential capability no matter how exponential the advantage. In 1922, the strategic reality of the flying boat outstripped the potential advantages of the rigid airship.

The Centralization of Administrative Bureaucracy: BuAer

The creation of BuAer was the Navy's answer to managing the growth of aviation with the ultimate strategic goal of an integrated force structure capable of operating from and with the fleet. The specialized needs of patrol aviation required specific material and organizational solutions. This meant development of aircraft capable of extended ranges and the ability to sortie with the main body of the Battle Fleet in a campaign across the western Pacific.

The 1919 General Board hearings on the expansion and construction of naval aviation policy pointed to the administratively fractured efforts to develop naval airpower under the office of Director of Naval Aviation. Personnel, funding, a decentralized administrative structure, and the outside political pressure provided by the debate over an independent air force all served to dilute what parochial coordination there was between the organizational entities that advanced naval aviation through WW I.¹⁶³ The organizational structure for naval aviation was arranged beneath the Chief of Naval Operations. The Director of Naval Aviation was Captain Thomas T. Craven. He was responsible for coordinating the efforts of the bureau chiefs to secure funding for development, construction, training, arming, and overhaul. The system worked ad hoc

¹⁶³ William F. Trimble, *Admiral William A. Moffett: Architect of Naval Aviation* (Annapolis, MD: Naval Institute Press, 1994), 65-72.

through WW I as a temporary solution that was in addition to the existing bureau system and not established as an integral component.¹⁶⁴ However, the six-year plan to expand naval aviation by eight-five percent could not be managed efficiently by the WW I construct.¹⁶⁵ Captain Hutchinson I. Cone, who had served on the staff of Admiral William S. Sims during WW I, testified before the General Board in April 1919 and pointed to the lack of administrative authority in the Department of Naval Aviation under OpNav.

The Department is not rigged to keep up to date with changes in Naval Aviation. There is not enough cooperation between the bureaus to keep up with modern developments. The airplane itself is too small and its parts are too widely separated in the different Bureaus. It is exactly parallel case to the torpedo. With Steam Engineering building the engine, Ordinance, the warhead, and C&R the hull. . . . As I view the present office of the Director of Naval Aviation, he is neither fish nor fowl. He is not a Bureau although he is held responsible for a good many things like a Bureau chief. He hasn't any authority over any technical subject under him although he does get the representatives of the different Bureaus together to meet with him but he has no real authority over them. I believe that aviation is of enough importance and different enough from the other Bureaus to develop a separate Bureau for it.¹⁶⁶

It was necessary to amend the contemporary bureaucracy in order for naval aviation to sustain continued growth through the decade following WW I.

The research and design, as well as the production and procurement of both heavier-than-air and lighter-than-air craft were under the administration of the combined efforts of the Director of Naval Aviation, BuC&R, Bureau of Steam Engineering (BuEng), and BuNav, and the Bureau of Ordinance (BuOrd). This resulted in parallel

¹⁶⁴ Trimble, *Admiral William A. Moffett*, 65.

¹⁶⁵ Naval Aviation Policy: Material and Personnel, 25 April 1919, NARA, PHGB, 1919, vol. 3, 769.

¹⁶⁶ Naval Aviation Policy, 23 May 1919, NARA, PHGB, 1919, vol. 3, 1004.

efficiency and duplicate efforts that could not sustain the rapid growth of naval aviation into the early 1920s. For example, the C-series non-rigid airship was designed by the BuC&R and the construction of the envelope was contracted to Goodyear.¹⁶⁷ BuC&R had to go through BuEng for contracted engines from Curtiss Aero Plane and Motor Company. The control car was built by the NAF in Pennsylvania (also under BuC&R), the armament was developed and provided by BuOrd, and the personnel were trained and detailed by BuNav.¹⁶⁸

Captain Thomas T. Craven, Director of Naval Aviation under OpNav testified in May 1919 on the matter of bureaucratic overlap and inefficiency with respect to naval aviation:

The present plan is that C&R looks out for its own particular work; Steam Engineering does the same with engines and so on; but the Director of Aviation is really without status. He answers unpleasant questions about whether a man should fly in a liberty loan machine or not, and in his office I think there is a good deal of duplication of work . . . the thing is not harmoniously arranged at all . . . I think the idea has been to give the technical Bureaus the technical parts of aviation, that there has been sufficient coordination of the different activities.¹⁶⁹

Craven's remarks about the challenges of his own duties illustrate the fact that he brought those difficulties to light in the forum of the General Board with the intent of finding a viable solution to the problem of how to best proceed with the growth of naval aviation. Though service parochialism resisted the creation of BuAer, the realization was understood at the highest level of leadership.

¹⁶⁷ Vaeth, 19-21.

¹⁶⁸ Swanborough and Bowers, 567.

¹⁶⁹ Naval Aviation Policy: Material and Personnel, 6 May 1919, NARA, PHGB, 1919, vol. 3, 884-885.

These difficulties were also present within the overall management of aviation personnel. Aviation needed young well-trained officers and enlisted men to man the growth planned for the first half of the 1920s. However, until aviation was validated as a career path and formalized within the parochial bureaucracy, it would not be career enhancing to be in aviation. Though the leadership declared the next six years as “developmental,” this applied to manning as well as material development. By as early as 1919, aeronautical courses were standardized as basic curriculum at the Naval Academy, and there was implicit discussion at the level of the General Board that cultivated an atmosphere of administrative change toward the creation of an aviation Bureau.¹⁷⁰ The continued testimony of Captain Thomas T. Craven in the spring of 1919 once again highlights the need to bureaucratically validate naval aviation:

Captain Craven: I think that certain legislation is in order for the definite establishment of naval aviation. I fail to see how aviation can go on and hold its own today when every detail of business is being pushed hard, unless certain people are behind aviation and personally interested in it, and will push as hard as they can. We talk about friction between corps. Friction is a healthy sign. It means progress and that the big machine is moving. Friction does not occur unless there is motion. It is something that we all must face. A successful administration is one at the head of which there are men who can appreciate that human friction is ever present where there is human activity. The important thing is to control the friction - that is, to see that it doesn't too any damage. . . . Aviation suffered from the outbreak of the war due to the fact that there weren't sufficient people behind it who were personally and permanently interested in it. Those that were interested in it were faced by others in whom existed a deep-rooted conservatism. Aviation was subject to the good will and assistance of those who might help it and suffered keenly from the lack of support of those who were not interested in it. We have got to give it a definite status.¹⁷¹

¹⁷⁰ Naval Aviation Policy: Material and Personnel, 6 May 1919, NARA, PHGB, 1919, vol. 3, 797-798.

¹⁷¹ *Ibid.*, 789-799.

Craven's testimony emphasizes the healthy friction that must occur in a forward moving organization. This "friction" needed to be managed within an established system in order to "see that it doesn't do any damage."¹⁷² Craven's point was that until there was a functioning bureaucracy to support its growth, naval aviation would rise and fall with the efforts of individuals. Yet, the thorny issue of administrative centralization of naval aviation was not solved until 1921.

Personnel issues, funding, and a weak bureaucratic administrative organization with respect to aviation had to be overcome before the grand ideas for a six-year aviation development plan could take shape.¹⁷³ The dialogue raged on until 12 July 1921 before the creation of BuAer was able to centralize the authority required to advance naval aviation into the next decade. Intra-service parochialism would continue to resist administrative change until the political threat of a unified air force threatened to usurp naval aviation altogether.¹⁷⁴

Brigadier General William Mitchell testified before the General Board in April of 1919 that the advances of aviation would soon render the contemporary naval combatants defenseless from shore-based air attack.¹⁷⁵ Mitchell lobbied for the creation of an independent air force and, with the assistance of Senator H.S. New, introduced legislation

¹⁷² Naval Aviation Policy: Material and Personnel, 6 May 1919, NARA, PHGB, 1919, vol. 3, 788-789.

¹⁷³ Development of Naval Aviation Policy, 17 April 1919, NARA, PHGB, 1919, vol. 2, 656-657.

¹⁷⁴ Trimble, *Admiral William A. Moffett*, 68-71.

¹⁷⁵ *Ibid.*, 68-69.

in the fall of 1919 to create a separate air force.¹⁷⁶ The initial legislation was defeated but Mitchell again attempted to arrogate the responsibility of coastal defense from the Navy by attaching a rider to an Army appropriations bill in the spring of 1920. The rider confined naval aviation solely to embarked operations with the fleet.¹⁷⁷ However, the Secretary of the Navy, Josephus Daniels was able to preserve the Navy's control over its shore-based aircraft. The maneuver on the part of General Mitchell would have left the Navy without any viable means for long-range reconnaissance for the fleet.

Naval leadership who had previously avoided the creation of a new bureau saw no choice but to solidify the bureaucracy by centralizing the administration into the BuAer.¹⁷⁸ The interservice parochialism was only part of the challenge faced by the leadership of Captain Craven and his successor Admiral William A. Moffett. A large portion of the political struggle for the preservation of naval air arm was the battle for the narrative.¹⁷⁹ Moreover, much of the politics were played out in a public forum. This struggle culminated with the sinking of the decommissioned German battleship *Ostfreisland* by Army and Navy aircraft off the coast of Virginia in July of 1921. Though the legislation for the creation of BuAer was signed that same month, the public relations battle between Moffett and Mitchell would play out into the late 1920s.

The sinking of the battleship *Ostfreisland* in July of 1921 was also significant because it involved the refinement of tactics for shore-based patrol aviation in a fleet

¹⁷⁶ Trimble, *Admiral William A. Moffett*, 68-69.

¹⁷⁷ *Ibid.*, 72.

¹⁷⁸ *Ibid.*, 81.

¹⁷⁹ *Ibid.*, 9.

action. The F-5-Ls were given a sector to reach and then report the position of the ‘enemy’ fleet to the remaining air units still on the ground. This was accomplished along with bombing from the F-5-Ls as well.¹⁸⁰

By August of 1921, BuAer was under command of Admiral William A. Moffett and had the responsibility for “all aeronautic planning, operations and administration.”¹⁸¹ BuAer was the authority for the technological improvement, research, procurement, and management of the NAF.¹⁸² It was this administrative construct that coordinated the industrial base, the operational development, and the technological innovation for patrol aviation through the rest of the interwar period. Although the creation of BuAer consolidated the strategic priorities and developmental resources of naval aviation, patrol aviation continued to evolve gradually from its post-WW I paradigm until 1922.

The technological pursuit of a replacement aircraft for the aging fleet of WW I surplus H-16s and F-5-Ls required an extensive research, design, and production effort that private industry was unable to undertake on its own in 1922.¹⁸³ It took the newly established influence of BuAer under a respected naval flag officer to coordinate the strategic requirements of OpNav and the General Board while reconciling a frail and defensive civilian aircraft industry to leverage continued procurement.¹⁸⁴ Unlike WW I,

¹⁸⁰ Air Warfare: Independent Air Force, 26 June 1922, NARA, PHGB, 1922, vol. 2, 517.

¹⁸¹ Trimble, *Admiral William A. Moffett*, 82.

¹⁸² *Ibid.*

¹⁸³ *Ibid.*, 69-72.

¹⁸⁴ *Ibid.*

Naval leadership managed the changes incrementally and patrol aviation evolved along the foundational lines of strategic prioritization and technological possibility.

Research and development, design, production, procurement, and maintenance of the next generation of naval aircraft required the cumulative efforts of naval leadership, private industry, and federal government appropriations. Patrol aviation evolved alongside carrier aviation during this period with varying degrees of success and failure. Strategic capability was largely tied to technological advancements that translated to operational achievement after being tested in Fleet Problems.

The foundations for the future of patrol aviation were laid during the pivotal years of 1919 to 1922. The debate over how best to develop naval aviation for the role of long-range scouting in support of the Battle Fleet's execution of War Plan Orange divided the technological efforts into the camps of heavier-than-air and lighter-than-air craft development. The restrictions of the 1922 Washington Naval Treaty focused naval leadership toward the strategic requirement for patrol aviation to be an integral part of the treaty fleet that was being constructed to operate in the vast reaches of the Pacific. The remainder of the interwar period was marked by incremental milestones of the foundational concepts from this early period.

Private Industry: A Balance of Procurement and Proprietary Design Control

BuAer coordinated the efforts of its own organic research and development capabilities resident in the NAF in Philadelphia. This coordination helped salvage the failing aircraft industry in the United States and enabled both maintenance of the contemporary fleet of patrol aircraft while developing the next generation of flying boats

and rigid airships to support the fleet. Under the leadership of Admiral William A. Moffett, BuAer leveraged the specialized needs of naval aviation and the limited industrial experience to maintain control of the procurement process for aircraft development and production while navigating the political pressures of the period.¹⁸⁵

It had been common practice for the military to acquire the design rights for an aircraft and then put the contracts up to bids from the private aircraft manufacturers to secure bulk production.¹⁸⁶ The post-WW I drawdown in aviation created a struggle over the competition of private industry with the NAF for both design and production of the next generation of naval aircraft. BuAer instituted the 1922 policy of compromise for the use of the NAF as a test and development site in order to cooperate with private industry, which had complained that the NAF was creating unfair “competition with the civilian aircraft industry in the construction of aircraft, engines, and accessories.”¹⁸⁷ Under Moffett, the NAF remained open but only as a research and developmental test bed. The small numbers of aircraft that the NAF did produce after 1922 were “highly experimental” and served as prototypes for eventual bulk orders sustained by private industry.¹⁸⁸ By 1923, all major production from the NAF had ceased.¹⁸⁹

¹⁸⁵ Trimble, *Admiral William A. Moffett*, 8-12.

¹⁸⁶ Trimble, *Wings For the Navy*, 69-73.

¹⁸⁷ Report of select committee of inquiry into operations of the United States air services, 3 February 1926, NARA, PHGB, 1926, vol. 1, 138.

¹⁸⁸ *Ibid.*

¹⁸⁹ Trimble, *Wings For the Navy*, 69.

Republican Congressman Florian Lampert chaired a special house committee in March 1924 airing the grievances of the aircraft industry condemning perceived federal competition in the design and production of aircraft.¹⁹⁰ The Lampert Committee challenged the NAF's existence by recommending, "procurement be separated from operation in all government air services."¹⁹¹ Admiral Moffett's testimony before the General Board in February 1926 defended the importance of BuAer's role in the design, and procurement:

I am opposed to this (*procurement being separated from operation in all government air services*). I think it is wrong in principle. Because if you are responsible for the operation, you wish to have control over your supply instead of being dependent on some outside agency. If you have to depend on some other agency not under your control, you will not be able to produce the results you desire in operating. . . . If you have to depend on another agency then you could not hold them responsible. That is the reason we didn't want to turn helium over to the Bureau of mines, because if we can't get helium, we can't operate.¹⁹²

In September 1925, the combination of the disaster of the *Shenandoah* along with the loss of the Navy PN-9 on its attempted long-distance flight from San Francisco to Honolulu served to bring the debate to public attention. Political pressure mounted in the form of a presidentially appointed board of inquiry led by Dwight Morrow.¹⁹³ The Morrow Board elicited testimony from BuAer that defended the existence of the NAF by arguing that "specialized manufacturing was needed . . . the NAF was restricted to

¹⁹⁰ Trimble, *Wings For the Navy*, 70-73.

¹⁹¹ Report of select committee of inquiry into operations of the United States air services, 3 February 1926, NARA, PHGB, 1926, vol. 1, 148.

¹⁹² *Ibid.*, 148-149.

¹⁹³ Trimble, *Wings For the Navy*, 73.

originating designs that filled particularly demanding naval requirements.”¹⁹⁴ This was especially true in the case of the flying boat and the rigid airship. Testimony before both the Lampert Committee and Morrow Board led to the passing of legislation in 1926 that called for the building of 1,000 aircraft over a five-year period. The legislation ensured the guarantee of long-term production contracts. This allowed private industry to stabilize from the post-WWI stagnation.¹⁹⁵

Aircraft procurement under BuAer balanced design and production in such a way that it was mutually beneficial for the Navy and the private aircraft industry. The Navy was able to retain control of research and design to ensure that its specialized needs were met, and private industry was able to reap the benefits of large-scale production demand without incurring the overhead cost for technological development.¹⁹⁶ “All told the Naval Aircraft Factory spent in excess of \$1.5 million between 1919 and 1930, exclusive of engines, overhead and depreciation, to bring the PN to maturity.”¹⁹⁷

The interdependent relationship between the Navy and private industry continued through the late 1920s. However, by 1931 imbalance once again threatened the advance of naval aviation. By 1931, the five-year building plan funded by the 1926 Lampert-Morrow induced legislation had expired and the austerity of the great depression was cutting deeply into the BuAer budget.¹⁹⁸

¹⁹⁴ Trimble, *Wings For the Navy*, 74.

¹⁹⁵ Trimble, *William A. Moffett*, 11.

¹⁹⁶ Trimble, *Wings For the Navy*, 101-102.

¹⁹⁷ *Ibid.*, 102.

¹⁹⁸ *Ibid.*, 120-123

Lighter-than-air Development: Rigid Airships

The Navy was committed to the possibility of the rigid airship as a long-range scout for the fleet. The advantages in range endurance and payload put lighter-than-air technology well beyond the reach of anything that contemporary heavier-than-air craft could achieve. With the tactical precedence having already been established by the German is in WW I, there was little to convince the United States that the technological pursuit and operational integration of rigid airships was not the primary solution to the strategic problem of long-range scouting.

Construction of the framework for ZR-1 (lighter-than-air, rigid #1) began in NAF in January of 1921.¹⁹⁹ The NAF accomplished the construction of the twenty-five tons of duraluminum framework. The airship was assembled at Naval Air Station Lakehurst, NJ. Named the USS *Shenandoah*, ZR-1 was powered by six 300-horsepower Packard engines. It was 680 feet long and, with a crew of twenty-three, had a range of 4,000 miles.²⁰⁰ ZR-1 was commissioned USS *Shenandoah* on 10 October 1923. *Shenandoah* was accepted and began flying that winter.²⁰¹ In August 1924, she successfully moored to a surface vessel in Narragansett Bay, MA. The USS *Patoka* had been converted from a fleet oiler to become the first rigid airship tender.²⁰² This operational demonstration along with its replacement of hydrogen with helium from gas mines in Texas was another step

¹⁹⁹ Trimble, *Wings for the Navy*, 58.

²⁰⁰ Vaeth, 26.

²⁰¹ *Ibid.*, 26-29.

²⁰² *Ibid.*

toward BuAer's goal of developing the rigid airship as a viable answer to the fleet's long-range scout problem.²⁰³

Photo # NH 57994 USS Shenandoah moored to USS Patoka, circa 1924



Figure 2. USS *Shenandoah* (ZR-1) Moored to the USS *Patoka* (AO-9), circa 1924

Source: NavSource Naval History, Photo # NH 57994, "USS *Shenandoah* (ZR-1) Moored to the USS *Patoka* (AO-9), circa 1924," The Naval Historical Foundation, U.S. Naval History and Heritage Command, accessed 19 April 2015, <http://www.navsource.org/archives/09/19/091900906.jpg>.

The *Shenandoah* also conducted two tactical exercises with the Scouting Fleet during the summers of 1924 and 1925. The objects of these limited exercises was to

²⁰³ Vaeth, 26-29.

“determine the value of rigid airships in overseas scouting.”²⁰⁴ The report from the commander of the Scouting Fleet, Admiral McCully stated, “The Airship *Shenandoah* was employed in exercises but without demonstrating any extra-ordinary ability for scouting work.”²⁰⁵ The *Shenandoah* had participated in a scouting problem to locate the USS *Texas* off the Virginia coast. The exercise concluded with the *Texas* locating the airship approximately twenty-three minutes before the airship located it. Despite the poor tactical showing, the report from McCully was more positive about the potential capability of the rigid’s role as a scout: “Her possibilities should not be measured by this exercise alone. With further experience she will undoubtedly much improve her performance and will be a valuable adjunct to the Scouting Fleet.”²⁰⁶

The *Shenandoah* spent the month of October 1924 touring the country on a public affairs mission. From her homeport in Lakehurst NJ, she flew to Texas, California, Washington State, and back to Lakehurst. The *Shenandoah* was refilled with helium in September 1925 and departed for a second such tour of the Midwest where she crashed on 2 September in a thunderstorm over Ohio, killing fourteen of the forty-three men on board.²⁰⁷

²⁰⁴ “Policy Regarding Rigid Airships and Appurtenances,” 4 January 1926, NARA, PHGB, 1926, vol. 1, 6-7.

²⁰⁵ *Ibid.*, 8.

²⁰⁶ *Ibid.*

²⁰⁷ Vaeth, 34-35.

Photo # NH 98997 USS Shenandoah's wrecked after section, September 1925



Figure 3. Wreckage of the *Shenandoah* (ZR-1) in Southern Ohio

Source: NavSource Naval History, Photo # 98997, “Wreckage of the *Shenandoah* (ZR-1) in southern Ohio,” U.S. Naval History and Heritage Command, accessed 19 April 2015, <http://www.navsource.org/archives/02/99/02990119.jpg>.

ZR-3, later renamed the USS *Los Angeles*, was built in Germany by the Luftschiffbau-Zeppelin Corporation and flown to the United States on 15 October 1924. The *Los Angeles* was roughly the same size as the *Shenandoah* but was powered by five German-built, 400 horsepower Maybach engines.²⁰⁸ The *Los Angeles* spent the fall and winter of 1924 to 1925 flying in the Lakehurst area, operating with the rigid airship tender, *Patoka*. While in service, the *Los Angeles* made 331 flights and was decommissioned in 1932; a full three years before the rigid airship program was

²⁰⁸ Vaeth, 31-32.

halted.²⁰⁹ The experimental flights with the *Patoka* were made to test the proof of concept that rigid airships eventually could operate with the fleet.

The loss of the *Shenandoah* and the persistent difficulties of lighter-than-air development marked a significant material setback in Moffett's pursuit of rigid airship technology. General Board hearings in early 1926 wrestled with the future policy and revisited the strategic foundations of lighter-than-air craft for naval use. As Chief of BuAer, Moffett opened his testimony before the General Board on January 4 with the following statement:

The whole matter of Lighter-than-air development within the naval organization is at a crucial stage. The policy of the Department is to carry on the development and trial of rigid airships and to continue the use of these airships to find out whether they are practical or not. We had the *Los Angeles* and the *Shenandoah*, having lost the *Shenandoah*, think we must carry on and finish what we started or stop altogether. That is why I say this is crucial. . . . The whole program will stop if you do not replace the *Shenandoah*. The rigid would be washed out for our purposes.²¹⁰

The only remaining rigid airship that the Navy had was the *Los Angeles* and it was reserved for commercial and training use only.²¹¹ Although evidence was mounting against rigid airship technology, the naval leadership persisted in continuing its development. High costs of continuing the program (\$14 million over the next five years) along with the steady stream of operational and technological problems that went with the complex developmental process all served to send the leadership back to the strategic drawing board for validation that the capability was worth the cost. Captain W. H.

²⁰⁹ Vaeth, 44.

²¹⁰ "Policy Regarding Rigid Airships and Appurtenances," 4 January 1926, NARA, PHGB, 1926, vol. 1, 2.

²¹¹ Vaeth, 30-31.

Standley Chief of the Op12 gave testimony concerning the strategic priority of rigid airships as long-range scouts in the current war plans:

The duty assigned to lighter-than-air rigid dirigibles is that of scouting. . . . The vulnerability of the type is one of the greatest objections to its use and unless it has some means of self-defense a single airplane can certainly put it out of business . . . as far as its development in the present time I can see nothing in the development that would indicate that the dirigible is of any great importance from a military point of view . . . on the other hand, I don't believe we can afford to neglect the possibility and to study any developmental work on them. In other words, I think that we should continue developmental work on them. There is another feature that I think we need to consider which I think is a political feature. The Navy is charged with the development of rigid dirigibles . . . I'm quite sure that if the development of lighter-than-air craft is stopped I am quite certain under those conditions the Army will want to take it over and develop lighter-than-air. Personally, I don't think we want to be placed in that position.²¹²

Strategically, the long-range scouting capability of the rigid was not considered realistic in 1926. The Board members went as far as to debate the role that German rigids played in the Battle of Jutland in order to help justify the continuation of the program.²¹³ Yet the political ramifications of giving the program over to the Army were seen as more costly.

Another reason that the Navy would not give up on the rigid was the treaty system. The 1922 Washington Naval Treaty limited capital ship building and the building of forward bases.²¹⁴ With these restrictions in mind, it was imperative that the United States built to treaty limits in as many classes and locations as possible in order to keep pace with the international arms race of the five powers who signed the treaty. Since aviation was relatively untouched by the treaty, rigid airship technology was an area that

²¹² "Policy Regarding Rigid Airships and Appurtenances," 4 January 1926, NARA, PHGB, 1926, vol. 1, 26.

²¹³ *Ibid.*, 41-43. The Board re-hashed the Office of Naval Intelligence report on rigid airship contribution to the Battle of Jutland.

²¹⁴ Kuehn, *Agents of Innovation*, 1-3.

Great Britain was building. The Navy felt pressure to keep up where it could and lighter-than-air was an area where, by the mid-1920s, the playing field was equal if not in favor of the U.S. Navy. Admiral Moffett's testimony before the General Board urges the U.S. building of lighter-than-air craft in parallel with its international naval competition:

In view of the military importance of this type of craft and the renewed rigid activities in Great Britain and Japan. This bureau recommends that appropriation be requested from Congress for sufficient funds to permit this country to duplicate the rigid program of Great Britain and Japan as a minimum construction program . . . I think so because I look upon the rigid airships as a part of a balanced fleet. If that is true, we should keep up with Great Britain.²¹⁵

It is apparent that the pursuit of strategic material balance helped to keep BuAer from turning away from the mounting difficulties of lighter-than-air development.

In terms of long-range scouting, what ultimately cemented naval leadership to its continued commitment of rigid airship development was the seduction of its technological potential and strategic possibilities. The strategic comparison of what was currently available to what could be attained must be considered. The General Board weighed the value of 10,000-ton scout cruiser against the potential of the rigid airship in terms of cost, range, ability. The scout cruiser concept was critical to the early development of the treaty fleet since they were not limited until the London Naval Treaty in 1930.²¹⁶ It had a range of 16,000 miles and cost roughly \$17 million to construct. BuAer argued that the current pursuit of rigid technology achieved a 5,000-mile range at

²¹⁵ "Policy Regarding Rigid Airships and Appurtenances," 5 January 1926, NARA, PHGB, 1926, vol. 150.

²¹⁶ Kuehn, *Agents of Innovation*, 106-108.

one-quarter of the cost and three times the speed.²¹⁷ BuAer pursued development of mooring rigid airships at sea from the tender USS *Patoka* in 1925. The experimental flights were made with the intent of eventually refueling at sea to increase the operational range of airships making them comparable to the scout cruisers.²¹⁸ On 5 January 1926, Captain Steele concluded the discussion with his remarks on the need to continue the development of the rigid airship:

The principle naval mission of the rigid airship is scouting and reconnaissance and this mission should be kept clearly in mind as to the utility of these craft in the scheme of naval organization. All other issues to which airships might be put are side issues and their consideration should not be allowed to cloud the issue. The Los Angeles went from Lakehurst to Bermuda in 12 hours and to Puerto Rico in 31 hours. No type of surface ship in existence or contemplated can equal this performance. . . . Taking these performances of this airship into account, it can be easily imagined what value an airship can be in reconnaissance. It must be imagined because the Navy has not had the opportunity to prove the airships as scouts. The few problems worked out with ships of the fleet and Shenandoah are only of value in knowing that the airship can scout. These conclusions are no more conclusive than could be drawn from a single surface scout . . . it is submitted that a line of airship scouts could cover as much territory as twice the number of surface scouts assigned to the same mission. . . . The cost of a cruiser is said to be 17 million dollars and the cost of a rigid airship is estimated at about one-third that sum.²¹⁹

This statement captures the approach of BuAer toward advancing aviation in the 1920s. The spirit of innovation resident in the potential advances of rigid airship technology overshadowed all logical trepidation about a fledgling program that was wrought with uncertainty and risk of failure.

²¹⁷ “Policy Regarding Rigid Airships and Appurtenances,” 5 January 1926, NARA, PHGB, 1926, vol. 1, 53-56.

²¹⁸ *Ibid.*, 60-61.

²¹⁹ *Ibid.*, 62-63.

BuAer's design teams incorporated technological innovations unique to the Navy's first generation rigid airships. The *Shenandoah* and the *Los Angeles* had water condensers in their engines to recover the water in their exhaust gasses to compensate for the weight loss due to burning gasoline in flight.²²⁰ BuAer's coordination with the Department of the Interior and the Bureau of Mines led to the development of the helium industry, which gave the United States a complete monopoly.²²¹ BuAer had "plans for a semi portable plant for helium extraction . . . cooperating with members of the three departments, War, Navy, and interior." The Navy utilized the Petrolia and Nacona fields in Fort Worth, Texas to supply its rigids with helium gas with storage facilities at Naval Air Station Lakehurst, NJ to accommodate roughly 8.5 million cubic feet of the gas. The Navy's annual budget for helium in 1926 was \$500,000. The estimate to sustain three rigid airships with helium was twice that.²²²

Naval leadership also developed the operational concept of combining heavier-than-air craft with rigid airship design in order to capitalize on the strengths of both platforms. The resulting effort of BuAer culminated in what amounted to a flying aircraft carrier. The *Los Angeles* employed a glider aircraft while in flight over Washington, DC on 31 May 1930.²²³ This experimentation with heavier-than-air craft led to the adoption of the mothership design for scout fighters launched from rigid airships *Akron* and *Macon*

²²⁰ Vaeth, 57.

²²¹ "Policy Regarding Rigid Airships and Appurtenances," 5 January 1926, NARA, PHGB, 1926, vol. 1, 20-24.

²²² *Ibid.*, 23-24.

²²³ Vaeth, 75.

in the early 1930s.²²⁴ The British were the first to launch heavier-than-air craft from non-rigid dirigibles in 1919. BuAer and the General Board discussed the technical feasibility as well as the strategic implications of pursuing “airships carrying airplanes.”²²⁵

Experiments were planned to try launching fighter aircraft from the Shenandoah to “crystallize ideas on this and see what was possible.”²²⁶ Mr. Star Trustcott of BuAer testified before the General Board on 4 January 1926. Trustcott’s account illuminates the strategic and tactical vision that BuAer was realizing in 1926 to develop rigid airship technology as a long-range fleet scout:

The airship as an airplane carrier will not enter into combat areas. The purpose of carrying those planes is to throw them out in front of the airship as an extended screen of planes that will make it unnecessary for the airship to even come in sight of the objective or the enemy. If you were trying to pick up a fleet at sea, to take your airship into the heart of that fleet would be foolishness. The airplanes then would be fast, high-speed scouts, since they would go ahead and radio back what they found.²²⁷

The testimony lends itself to the idea that there was still great possibility in the development of the rigid as a viable scout despite the mounting drawbacks. Not the least of which was the loss of the *Shenandoah* in the fall of 1925.

In 1926, Congress appropriated funds for the construction of two new rigid airships ZR-4, ZR-5, renamed *Akron* and the *Macon*. The Goodyear Corporation was

²²⁴ Swanborough and Bowers, 588.

²²⁴ *Ibid.*, 573.

²²⁵ “Policy Regarding Rigid Airships and Appurtenances,” 4 January 1926, NARA, PHGB, 1926, vol. 1, 14.

²²⁶ *Ibid.*

²²⁷ *Ibid.*, 17.

awarded the nearly \$8 million contract after having secured the rights for the Luftschiffbau-Zeppelin Corporation's North America patent rights.²²⁸ These craft were 785 feet in length and 6.8 million cubic foot envelopes with five 560-horsepower Mayback engines whose propellers were connected to special drive shafts that provided vectored thrust.²²⁹ The frame was made from three keels instead of the traditional four; the lack of a keel along the bottom of the airships enabled for the construction of an airplane hangar large enough for five scout fighters that were meant to leave and return by way of a Hook-on trapeze. The balloonets were upgraded to a synthetic infused compound instead of the traditional Goldbeaters skin made from cattle stomach.²³⁰

²²⁸ Vaeth, 61.

²²⁹ Swanborough and Bowers, 588.

²³⁰ Vaeth, 72-74.

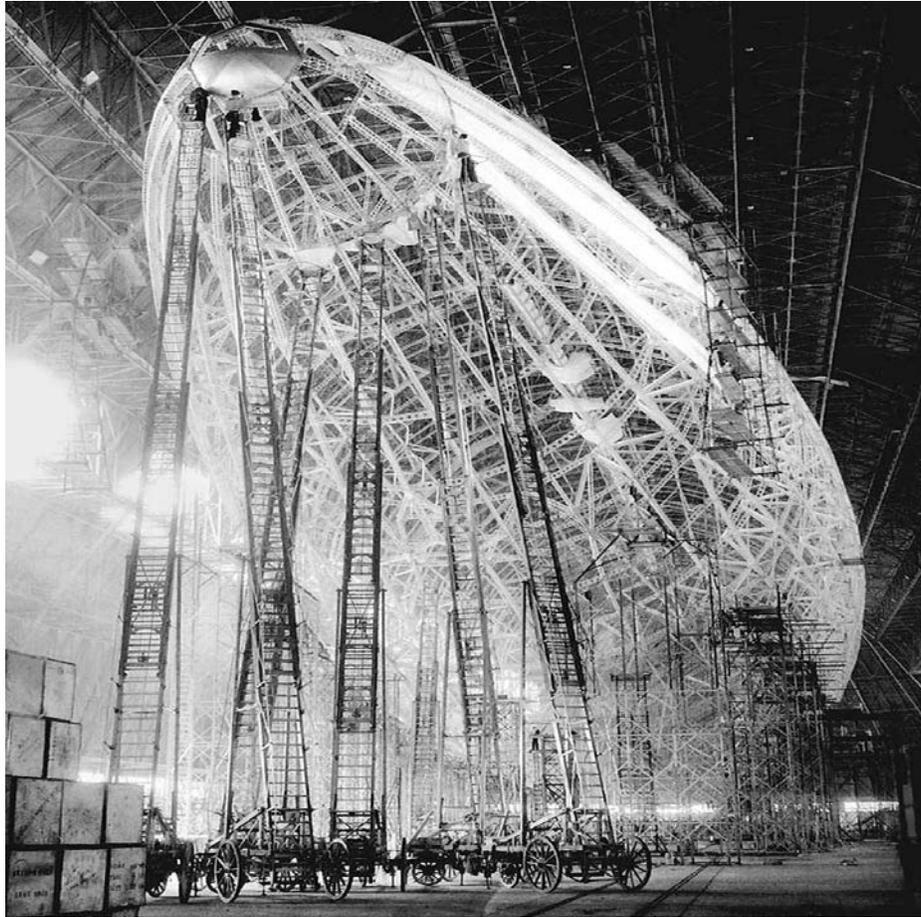


Figure 4. Construction of the USS Macon (ZR-5)

Source: Airships.net, “Construction of USS *Macon*,” accessed 19 April 2015, <http://www.airships.net/wp-content/uploads/macon-construction.jpg>.

Heavier-than-air Developments: The PN Series Flying Boat

Despite the herculean efforts of BuAer to advance lighter-than-air technology for long-range scouting, there was also a corresponding emphasis on developing heavier-than-air scouts to support the fleets’ advance into the western Pacific. The naval leadership’s policy to develop a treaty fleet that was balanced in both strategic priority and operational ability allowed for what could be considered a parallel technological

effort to achieve the strategic capability of a long-range aerial scout. BuAer explored as many avenues as was within its power to achieve this end. Admiral Moffett's testimony to the General Board in January of 1926 appeals to the broad spectrum of development that the Navy applied to the integration of aviation into the fleet:

Airships and airplanes are not competitive branches of aeronautics but are complementary. . . . No equitable conclusions can be reached by arguments for and against airships as compared with airplanes. Such arguments are similar to controversies on subjects such as battleships versus submarines and guns versus torpedoes. The correct answer in this case is that both airplanes and airships are necessary components of a well-balanced fleet in being and as a part of the nation's defense. To a naval power which develops aerial cooperation with the fleet along sound lines, airplanes and airships will be a vast accession of strength.²³¹

Moffett's testimony resonates the policies laid down in the General Board hearings at the close of WW I with the goal of developing aviation to its fullest extent and integrating it with the fleet at sea. Successful innovations were born out over time through the failure of the lesser options. It was in this way that strategic needs were met with technological possibility. Fear of failure was not part of the equation. Failure was not only an expectation of progress; it was a requirement.

The annual reports of the U.S. Fleet shows a fixed-wing scouting (designated VS) force in need of a material solution to overcome the strategic problem of integrating long-range scouting with the fleet. Until the legislation passed in 1926 that authorized and funded a five-year building program for naval aviation, the long-range patrol force was

²³¹ "Policy Regarding Rigid Airships and Appurtenances," 5 January 1926, NARA, PHGB, 1926, vol. 1, 79.

subjected to significant material shortages.²³² This lean period came at a time when the Navy was attempting to experiment with how best to incorporate aviation into the fleet.

The Annual Fleet Reports of the U.S. Fleet to the CinCUS were critical of the effects that the low material state of the patrol squadrons (designated VS at the time) had on mission effectiveness. Operationally the fixed-wing scout (VS) squadrons were little more than utility squadrons performing torpedo recovery, mail carrying, smoke screen laying, plane guard, photography, and passenger services. It was rare that VS missions consisted of long-range patrol in support of the fleet on the high seas. This was primarily because the H-16s and F-5-Ls being flown by the VS squadrons were obsolete and had neither the range nor endurance to operate with the fleet at sea.²³³ The VS base of operations was usually a shore establishment or a protected harbor with a mother-ship aircraft tender. The tenders were inadequate to keep up with the fleet (a criticism that rang true for most of the interwar auxiliaries) but also the tenders *Aroostook* and *Gannet* had inadequate berthing space and facilities to support seaplane operations with the fleet.²³⁴ The annual report of the Commander-in-Chief, Battle Fleet, Admiral Samuel S. Robison, states that:

The lack of adequate tenders and carriers are the outstanding need of the Aircraft Squadrons, and until these are provided, the Aircraft Squadrons cannot fulfill their mission as an aviation unit of the fleet. . . . Fleet aviation will progress very slowly until our aviation units are afloat. . . . The *Aroostook* and *Gannet* are not adequately provided for accommodations for personnel facilities for handling and

²³² Annual Report of Aircraft Squadrons, Battle Fleet, and 4 September 1926 to 30 June 1926, 1-5, Annual Reports of the PACFLT, 1919, 5, NARA, Annual Reports.

²³³ *Ibid.*

²³⁴ *Ibid.*, 4-5.

repairing planes. The addition of Langley will not materially affect this condition and more suitable vessels are needed.²³⁵

Robison's report on the material condition of the aircraft squadrons demonstrates a prevailing problem with heavier-than-air development throughout the 1920s. The specificity of separating the *Aroostook* and *Gannet* from the *Langley* was indicative of the operational distinction made by the differentiating between the future of carrier aviation and that of patrol aviation.

The operational epicenter of both carrier and patrol aviation lay in the ability for those aircraft to sortie with the fleet.²³⁶ This meant adequate seaplane tenders and aircraft carriers. The recommendation to develop adequate seaplane tenders is present in every annual report from the CinCUS throughout the period.

Along with the inadequate tenders, the aircraft themselves had grown obsolete. From 1922 to 1928, the last of the serviceable H-16 and F-5L WW I era flying boats were showing their age despite the best efforts of VS and VJ squadrons to extend the service life. Though BuAer had begun a design program for a replacement airframe in 1923 in the form of the PN series flying boat, the research and development process was still maturing.²³⁷ It was not until 1928 that the Navy was able to order large production contracts for the PN-10-12s.²³⁸ From 1923 to 1926, patrol aviation innovated within

²³⁵ The Annual report of the Commander in Chief, U.S. Fleet, 1924, Annual Report, Commander in chief, Battle Fleet, paragraphs 125-126, NARA, Annual Reports, 58-59.

²³⁶ Ibid.

²³⁷ E. R. Johnson, *American Flying Boats and Amphibious Aircraft*, 65.

²³⁸ Trimble, *Wings for the Navy*, 100.

austere conditions with respect to developing an operational solution to long-range scouting with the fleet at sea. The VS squadrons were decommissioned by 1926 and their aged aircraft were relegated to the duties of utility service squadrons (VJ). Vice Admiral R. H. Jackson, Commander-in-Chief Battle Fleet, in his report on the material condition of the aircraft squadrons, Battle Fleet stated:

Fixed wing utility squadron one (VJ) was decidedly handicapped throughout the year because of lack of proper equipment. The planes of the squadron are old, obsolete, and otherwise inadequate for the service required. Despite these difficulties, the squadron furnished utility service to the Battle Fleet throughout the gunnery periods.²³⁹

Jackson's report highlights the extreme material difficulties faced by the units still flying first generation patrol aircraft in 1926.

The PN Flying Boat program evolved from progressive enhancements to the F-5-L redesignated in 1922 as the PN-5/6.²⁴⁰ In 1923, BuAer authorized the experimental production of the PN-6/7. Though they outperformed the aging F-5-Ls, PN-7s were largely transitional due to their small numbers.²⁴¹ By early 1925, BuAer authorized the construction of a PN hull made of steel and covered with duraluminium. These two prototypes became the PN-8/9. They were 2,000 pounds lighter and more efficiently powered than their PN predecessors. The PN-9 test flight in May of 1925 set a new endurance record for flying boats of twenty-eight hours and thirty minutes in the air.²⁴²

²³⁹ The Annual Report of the Commander in Chief, U.S. Fleet for the period 3 October 1925 to June 30, 1926, 62 Part IV Aviation section 215-f, NARA, Annual Reports, 58-59.

²⁴⁰ E. R. Johnson, *American Flying Boats and Amphibious Aircraft*, 65.

²⁴¹ Trimble, *Wings For the Navy*, 92-94.

²⁴² *Ibid.*, 94.

BuAer was determined to demonstrate the long-range capability of the Navy's Flying Boat. On 31 August 1925, Commander John Rodgers led the flight of two PN-9s from San Francisco, CA. One of the aircraft turned back early with engine malfunctions leaving Rodgers to continue the flight on his own. However, Rodgers and his crew were forced down 400 miles east of Hawaii after running out of fuel.²⁴³ They had been airborne for twenty-five hours and traveled 1,840 miles. Although the attempt was a public failure it served to validate the strength and durability of the duraluminum hull as well as the continuation of the PN design program.

This led to the Navy's first all-metal flying boat when the NAF covered the wings of the PN-9 with duraluminum making it the PN-10.²⁴⁴ The NAF completed four PN-10s that were commissioned as flying test beds and used in the Canal Zone and the Caribbean. By June 1928, NAF modifications had progressed the design to the point where BuAer was prepared to offer production contracts to private industry as a replacement for the F-5-L. The PN-11/12 with its, all-metal construction was 2,000 pounds lighter than its predecessor and broke endurance and payload records for flying boats.²⁴⁵

By December of 1929 BuAer issued contract orders with Douglass Aircraft company (twenty-five PD-1s), Hall Alunimium Aircraft company (nine 1 XPH-1), Glen L. Martin Company (twenty-five PM-1s), Keystone Aircraft Corporation (eighteen PK-

²⁴³ Trimble, *Wings For the Navy*, 95-96.

²⁴⁴ *Ibid.*, 96.

²⁴⁵ *Ibid.*

1s), and Martin (twenty-five PM-2s).²⁴⁶ It is important to note that from 1921 the official aircraft designation “P” for Patrol and “D” for Douglas, “K” for Keystone, etcetera.²⁴⁷ although the designations differed, the manufactured variants were all based on the original PN-12 designed by BuAer via the NAF.²⁴⁸



Figure 5. PN-12

Source: Johan Visschedijk Collection, No. 12642, addition, “Naval Aircraft Factory PN-12 (A-7383 U.S. Navy,” Source unknown, 1000AircraftPhotos.com, accessed 19 April 2015, <http://1000aircraftphotos.com/Contributions/Visschedijk/Additions/12642addition.htm>.

²⁴⁶ Trimble, *Wings For the Navy*, 100.

²⁴⁷ Swanborough and Bowers, 11.

²⁴⁸ E. R. Johnson, *American Flying Boats and Amphibious Aircraft*, 62-68.

1930 London Naval Arms Limitation Conference

The London Naval Arms Limitation Conference in 1930 served as a continuation of the 1922 Washington Naval Conference. The capital ship building holiday extended the restriction of new battleship construction until 1936 as well as capping submarine and cruiser tonnage to a level that rendered the Navy's approach to long-range scouting untenable.²⁴⁹ The Navy "compensated for lack of capability by innovatively combining new technology with operational requirements generated by the Fortification Clause."²⁵⁰

The fortification clause of the 1922 Washington Treaty required a strategy founded on advanced basing and self-sustainability of combat power for the U.S. Fleet to secure its mobility and lines of communication across the western Pacific.²⁵¹ Naval planners and fleet commanders had spent the 1920s solving the problem of long-range scouting for the main body of the fleet in order to tactically support its maneuver against an opposing enemy at sea.²⁵² By 1930, naval leadership had formulated and tested the scouting forces necessary to screen and provide tactical information for the benefit of the fleet. For distant scouting, the Navy utilized a combination of cruisers, destroyers, aircraft, and submarines. CinCUS, Admiral William V. Pratt appeared before the General Board on 27 May 1930. His testimony reflects the Navy's approach to the long-range scouting problem up to the London Conference:

²⁴⁹ Kuehn, *Agents of Innovation*, 53-55.

²⁵⁰ *Ibid.*, 54.

²⁵¹ *Ibid.*, 2-5.

²⁵² Annual Reports of the Commander in Chief, U.S. Fleet for the period of 8 November, 1927 to 30 June 1928, 12, NARA, Annual Reports.

I would like to see the Scouting Fleet organized with sufficient carrier tonnage and sufficient numbers of cruisers to accompany these carriers in order to form what I think is a really effective scouting force. . . . The ideal scouting unit is to have a division of four cruisers with a carrier along with a division of six destroyers. . . . You expect to use those for distant work with submarines as a distant screen. You would throw them well out in advance. Attack and information they would be of tactical use but a tremendously long way in advance. What information they give would come back in advance of the fleet.²⁵³

Naval leadership had spent the eight years prior to the London Conference perfecting the coordination required to provide long-range scouting for the Battle Fleet. The standing solution of surface screen augmented by shipborne aircraft was made untenable by the restrictions of the London Naval Conference of 1930. The restriction on cruiser and submarine construction forced naval leadership to turn to aircraft in order to fill the capability gap. Carrier-based aviation and even designs for cruisers with “flying off decks,” were explored to augment the screen.²⁵⁴ Although it was a promising remedy to the scouting problem gap created by the London Naval Conference, long-range patrol aircraft for distant scouting was not yet a mature capability and its operational participation in Fleet Problems was still considered experimental. Rigid airship technology held the promise for extreme range and endurance and the flying boat had demonstrated the potential for operational practicality. However, BuAer was still in the process of developing the technology prior to being able to procure large numbers of aircraft to support fleet operations.²⁵⁵

²⁵³ Testimony of Commander in Chief, U.S. Fleet, in regard to needs of the fleet, 27 May 1930, NARA, PHGB, 1930, vol. 1, 177-180.

²⁵⁴ Kuehn, *Agents of Innovation*, 59-61.

²⁵⁵ Trimble, *Wings for the Navy*, 99-100.

Fleet Reorganization in Support of Development for a Pacific War

Due to the strategic influences of the Washington and London naval arms limitation treaties, significant operational changes in the U.S. Navy indicated a shift in priorities toward developing a fleet that could operate in a future Pacific conflict. Fleet reorganization and annual coordinated training events (called Fleet Problems) both facilitated and operationalized the concepts that were being discussed by the General Board and developed BuAer.²⁵⁶ These two events contributed to the ongoing development of patrol aviation and created conditions for tactical and operational growth of emergent technology. However, the continual reorganization of the seaplane squadrons through the 1920s reflected the operational gap that patrol aviation had with respect to operating with the fleet at sea. For the heavier-than-air flying boats, this was due to material factors such as slow aircraft development and the inadequacy of tenders. The lighter-than-air ships were still in an experimental phase of development and did not enter operational service with the fleet until 1931.

On 6 December 1922, another major reorganization of the U.S. Navy was initiated in accordance with General Order 94. This reorganization combined the Atlantic and Pacific Fleets into a single U.S. Fleet under the command of the CinCUS. The U.S. Fleet was divided into the Battle Fleet (U.S. Pacific coast) and the Scouting Fleet (U.S. Atlantic coast).²⁵⁷ These fleets operated the combat power of the Navy and both had air

²⁵⁶ Kuehn, *Agents of Innovation*, 168-171.

²⁵⁷ Marie B. Allen, National Archives Microfilm Publications Pamphlet, *Annual Reports of Fleets and Task Forces of the U.S. Navy, 1920-1941* (Washington, DC: National Archives and Records Service General Services Administration, 1974), 3.

components that included the seaplane tenders *Gannet* and *Aroostook* on the west coast and *Wright*, *Sandpiper*, and *Teal* on the east coast. Additionally, the Asiatic Fleet operated the tenders *Ajax* and then *Jason*.²⁵⁸

The U.S. Fleet was also divided into the Control Force (U.S. east coast) and the Fleet Base Force (U.S. west coast). These forces operated the auxiliary components of the fleet.²⁵⁹ This reorganization divided the fleet along operational lines instead of geographically. This put the Navy under a single Commander-in-Chief and enabled “subordinate Fleet and Force commanders’ direct communication with the Department in regard to matters concerning solely the Fleets or Forces under their respective commands.”²⁶⁰

By 1926, further reorganization of the Battle Fleet’s aircraft was necessary as more standardized aircraft types were supplied in increasing numbers to support carrier aviation.²⁶¹ The squadrons of the Battle Fleet, based on the U.S. west coast, were organized into the Carrier Group, and a Special squadron. The Carrier Group consisted of the USS *Langley*, and the two tenders *Aroostook*, and *Ganett*.²⁶² The aircraft of the Carrier Group consisted of the fixed-wing fighter (VF) and torpedo bomber (VT) squadrons that operated with the *Langley*. The non-carrier capable aircraft of the Battle

²⁵⁸ Kuehn, *Agents of Innovation*, 93-98.

²⁵⁹ Allen, 3-4.

²⁶⁰ Annual Reports of Commander in Chief, U.S. Fleet, Aircraft Squadrons, Battle Fleet, 4 September 1926 to 30 June 1927, Annual Reports of Commander in Chief, U.S. Fleet, with endorsements, NARA, Annual Reports, 1-4.

²⁶¹ *Ibid.*

²⁶² *Ibid.*

Fleet's Carrier Group consisted of a fixed-wing utility squadron (VJ). VJ Squadron ONE was organized in December 1926 and was made up of the few remaining serviceable PN-5/6 series aircraft.²⁶³ The duties of VJ Squadron ONE consisted of "torpedo recovery, photography, mail carrying, and passenger service."²⁶⁴ The Special Squadrons Wing consisted of the still experimental PN-10/11 series aircraft being fielded by BuAer through developmental efforts at the NAF.²⁶⁵ This small organizational footprint highlights the challenges that naval leadership faced in the late 1920s with respect to its lack of a suitable long-range patrol aircraft.

In the BuAer endorsement of the Annual Report of Commander in Chief, Battle Fleet for the period of 4 September 1926 to 1 July 1927, Admiral Moffett addressed the recommendation from the report that "Long range scouting planes and more suitable types of planes for utility service should be provided."²⁶⁶ Although BuAer's response to the material problem faced by the Battle Fleet on the Pacific coast was an assurance that material relief was in sight; there would be no large-scale production of the PN-11/12 series flying boats until 1929:

Long-range scout planes as embodied by the PN-11 type are being provided as rapidly as funds will permit. Several of this type have been allotted to the Battle

²⁶³ Annual Reports of Commander in Chief, U.S. Fleet, Aircraft Squadrons, Battle Fleet, 4 September 1926 to 30 June 1927, Annual Reports of Commander in Chief, U.S. Fleet, with endorsements, NARA, Annual Reports, 1-4.

²⁶⁴ *Ibid.*, 5.

²⁶⁵ Trimble, *Wings for the Navy*, 97-100.

²⁶⁶ Annual Reports of Commander in Chief, U.S. Fleet, Aircraft Squadrons, Battle Fleet, 4 September 1926 to 30 June 1927, Fifth endorsement BuAer of Annual Reports of Commander in Chief, Battle Fleet, Annual Reports of Commander in Chief, U.S. Fleet, with endorsements, NARA, Annual Reports, 2.

Fleet and others from the 1929 procurement funds will be supplied as rapidly as possible. As regards planes for utility service, it has heretofore been the policy for this bureau to avoid designing and building any particular type of plane for utility purposes solely. It has not been considered justifiable to spend badly needed funds toward the design and production of a non-military type.²⁶⁷

Moffett's remarks concerning this recommendation distinguished between the aircraft of the VS and VJ squadrons, and suggests that the creation of the VJ squadron was a way for the Navy to make maximum use of obsolete surplus war equipment while the follow-on generation of replacement aircraft came on line.

Patrol aviation was overshadowed by the efforts to bring carrier aviation to the fleet in the second half of the 1920s and the developmental efforts and resources for long-range patrol aviation were split by the heavier-than-air/lighter-than-air dichotomy.²⁶⁸

1927 "marked the beginning of actual employment of aircraft with and as a part of the fleet in concentrated maneuvers, in contradiction to the employment of the squadrons of different types independently."²⁶⁹ The squadrons of the Battle Fleet relied on the use of carrier aviation and short-range tactical scouts being catapulted from battleships and cruisers.²⁷⁰

²⁶⁷ Annual Reports of Commander in Chief, U.S. Fleet, Aircraft Squadrons, Battle Fleet, 4 September 1926 to 30 June 1927, Fifth endorsement BuAer of Annual Reports of Commander in Chief, Battle Fleet, Annual Reports of Commander in Chief, U.S. Fleet, with endorsements, NARA, Annual Reports, 2-3.

²⁶⁸ Ibid.

²⁶⁹ Ibid., 1.

²⁷⁰ Annual Reports of Commander in Chief, U.S. Fleet, 1927, "Phases of Fleet and Tactical Training with review of results, NARA, Annual Reports of Commander in Chief, U.S. Fleet, with endorsements, NARA Annual Reports, roll 6, 15-25.

There was little operational development of long-range patrol and reconnaissance heavier-than-air capability during this period of transition to the PN series aircraft. During this time, the Battle Fleet concentrations and tactical exercises highlighted the lack of long-range scouting. Naval leadership continued to develop schemes of maneuver that relied heavily on surface vessels performing the screening duties as scouts.²⁷¹ Aerial scouts in the form of rigid airships and long-range flying boats were still unavailable in quantities large enough to exercise in large-scale fleet concentrations. This lack of long-range airpower left the Navy with no choice but to rely exclusively on an insufficient number of light cruiser and the destroyer squadrons to maintain the protective screen around the main body of battleships and heavy cruisers.²⁷² In his 1926 report to the Chief of Naval Operations, Admiral Richard H. Jackson, CinCUS, reported on the shortage of cruisers in the scouting screens of the U.S. Fleet:

Time after time in fleet exercises, destroyers have proved their inadequacy as scouts. They have never proved satisfactory and are used as scouts only for lack of better vessels. In the light cruiser, we have an ideal scout. Light cruisers supplemented by aircraft is the best combination now known.²⁷³

The strategic dependence on light cruisers for long-range fleet scouting came to an abrupt end in 1930 when the second naval arms limitation treaty was signed in London by the

²⁷¹ Annual Reports of Commander in Chief, U.S. Fleet, 1927, "Phases of Fleet and Tactical Training with review of results, NARA, Annual Reports of Commander in Chief, U.S. Fleet, with endorsements, NARA Annual Reports, roll 6, 15-25.

²⁷² *Ibid.*

²⁷³ *Ibid.*, 6.

three powers. The London Naval Arms Limitation Conference further restricted capital ship construction and extended its limitations to light cruisers.²⁷⁴

From the standpoint of strategic planning, this limited the material options for the fleet to conduct long-range scouting. The Navy was channeled into relying, in part, on aircraft to fill the capabilities gap. The treaty system and the austere budgetary conditions of the Hoover administration made for lean appropriations after 1929.²⁷⁵ Modernization of the inadequate aircraft tenders suffered accordingly. The summary of the organization of the Scouting Fleet air squadrons from Vice Admiral Ashley H. Robertson describes the operational state of the VS squadrons attached to the USS *Wright*:

The present method of flying planes from base to base is most unsatisfactory and in wartime would prove very inadequate. In cruising, one tender must remain with the squadron while the other proceeds ahead to plant moorings and establish a base. These tenders must care for the squadrons while the tender which remained at the last base proceeds ahead and prepares the next base. The best progress that squadrons cruising by this method can make is approximately one-third the progress of surface ships. In addition, minesweepers and tenders are totally inadequate to care for the personnel of the squadron at the temporary bases. The selection of the temporary bases is further limited by the cruising radius of the planes and by that fact that these base must be in sheltered waters. The wear of the planes and the personnel in making flights of this nature is severe. . . . A carrier is essential to any air operation with the fleet. One or two 15,000-ton carriers should be assigned to the Scouting Fleet.²⁷⁶

Admiral Robertson's report highlights the repeated issues of inadequate tenders as well as the operational difficulties faced by the flying boat squadrons cruising with the fleet as long-range scouts. The excerpt uses the limitations of the seaplane squadrons as an

²⁷⁴ Kuehn, *Agents of Innovation*, 52-55.

²⁷⁵ *Ibid.*, 56-61.

²⁷⁶ Annual Reports of Commander, Scouting Fleet, for the period 9 November 1927 to 30 June 1928, NARA, Annual Reports, 9.

occasion to request aircraft carriers for the Scouting Fleet fell short as treaty restrictions and limited funding prioritized carrier aviation to the Battle Fleet on the west coast.

This forced the Scouting Fleet to innovate with the aviation that they had available for long-range scouting. Evidence of this resourcefulness can be seen in Robertson's report of the Scouting Fleet's organization of two aircraft squadrons to tender *Wright*:

Until the light carriers become available it is recommended that the *Wright*, *Sandpiper* and *Teal* be retained and that there be attached to the *Wright* the following:

<u>Squadron</u>	<u>Strength</u>	<u>Attached</u>
VS	18	<i>WRIGHT</i>
VS	6	<i>WRIGHT</i>

The eighteen planes squadron should be composed of convertible, single float high speed seaplanes with a cruising radius of not less than 600 miles, and the six-plane squadron should be composed of PN flying boats with minimum cruising radius of 1500 miles. With these two squadrons attached to the *Wright*, it will be possible to determine from active operations, the best and most efficient type for scouting operations.²⁷⁷

The Scouting Fleet continued to innovate and develop the operational concept of flying boat and mothership tender throughout the period and it was eventually this model that the Battle Fleet used to integrate patrol aviation with the fleet in the 1930s.

By 1929, the BuAer procured supply of second-generation patrol flying boats of the PN series began to reach the fleet. The promise of longer range and large numbers prompted CinCUS, Admiral William V. Pratt, to add a Patrol Wing to the air composition of the Battle Fleet. Patrol Squadron Seven (VP-7B) was established on 1 July 1929 and

²⁷⁷ Annual Reports of Commander, Scouting Fleet, for the period 9 November 1927 to 30 June 1928, NARA, Annual Reports, 8.

based on the *Aroostook*.²⁷⁸ The Scouting Fleet fielded two VP squadrons the same year. This material step forward would allow the Navy to continue to refine its long range scouting capability through the London Treaty whose restrictions threatened a well-developed scouting doctrine centered on the light cruiser.

The 1922 to 1931 period was crucial to the development of patrol aviation. Naval leadership in the form of the General Board, BuAer, and the operational leadership of the U.S. Fleet were forced to shape the existing treaty restrictions and fiscal limitations into material solutions as seen in the rigid airship construction program. When material or technological solutions were unavailable, naval leadership sought operational solutions.

During this period, the Battle Fleet's developmental efforts for naval aviation were clearly focused on carrier aviation. In a parallel effort, the Scouting Fleet innovated the operational concept of advanced basing by wedding the mothership seaplane tender to the flying boat. The result allowed for the eventual integration of patrol aviation with the fleet at sea. Naval leadership spent the remainder of the interwar period integrating the technological developments of both lighter-than-air and heavier-than-air patrol craft with the fleet on an operational and organizational level. The forum for this integration took the form of annual Fleet Problems and Strategic Joint exercises. Through the 1930s, naval leadership continued to develop and refine its organizational structure and bureaucratic administration to accommodate the strategic priorities required to build a fleet capable of winning a naval war in the Pacific.

²⁷⁸ Annual Reports of Commander in Chief, U.S. Fleet, for the period 1 July 1929 to 30 June 1930, NARA, Annual Reports, 6.

Chapter 5 will investigate the development of patrol aviation after the 1930 London Naval Arms Limitation Conference. The chapter focuses on the rise of the heavier-than-air solution to the long-range scouting problem; specifically the operational and organizational integration of the PBY Catalina and its employment using the advanced basing concept.

CHAPTER 5

1932 to 1941: AFTER LONDON

Patrol aviation had evolved slowly during the period leading up to the 1930 London Naval Conference. As late as 1932, the development of long-range aircraft to support the fleet in offensive advanced base operations was still considered experimental.²⁷⁹ This chapter will examine the final phase of strategic transformation and its influence on patrol aviation from 1932 to 1941. Pre-1930 development as a defensive patrol scout paved the way for patrol aviation to fulfill a more offensive role as a long-range reconnaissance and striking force able to operate from advanced bases in support of the fleet in a Pacific campaign. This transformation will be examined by looking at the technological, organizational, and operational determinants that naval leadership reconciled in order to effect that change.

After the London Naval Conference, the offensive capabilities of patrol aviation were re-examined by the General Board and by 1936, the role of the flying boat was recast as a component of the fleet striking force centered on battleships and carrier aviation. Rear Admiral Samuel W. Bryant, Chief of Staff of the War Plans Division testified before the General Board in August 1934 on the estimated role of patrol aviation in the Orange War Plan:

Question 1: In the formulation of war plans, are patrol planes primarily intended for the obtaining of information or for combat use?

Answer: Primary employment – information. Secondary use – combatant roles.

²⁷⁹ Miller, *War Plan Orange*, 175-179.

Question 10: has there been any study made by war plans division or by the fleet for use of patrol planes as a striking force?

Answer: in connection with the Orange campaign, they have prepared the tactical operating plan against the Marshall Islands . . . in the directive there is included the probability of the employment of VP planes not only in observing adjacent islands but in offensive operations against islands in the area and in operations with the Fleet as it progresses to the westward.²⁸⁰

It is clear that by 1934, the strategic concept of operating long-range patrol aircraft from advanced bases in the central Pacific in support of offensive fleet operations had matured to the point where it was an integral part of the Orange Plan.

Naval leadership affected three influential areas of development in order to transform patrol aviation from its pre-1930s role as a long-range defensive patrol capability, to an offensive long-range scouting and striking element of the fleet at sea. The first element that transformed the role of patrol aviation after the London Naval Conference was the technological challenges of reliable range, endurance, and payload. Short-range and lack of endurance plagued the P2Y flying boat. This problem was solved through the continued coordination between naval leadership (General Board, BuAer, and Op12), the civilian aircraft industry, and the federal government.

The second determining variable that effected the transformation of patrol aviation from coastal defense to long-range scout was the organizational construct of the fleet itself. Distinction between tactical and administrative roles of command had to be re-established in order to develop effective tactical units of long-range flying boats and then employ those units in coordinated fleet operations. The reorganization in 1933 that placed the VP squadrons under the cognizance of the Base Force illustrates that, at the

²⁸⁰ "Facilities for Enlarged Aviation Program," 10 August 1934, NARA, PHGB, 1934, vol. 1, 97.

operational level, naval leadership recognized the need for organizational centralization to effect efficient change.

The third element of change that finalized the transformation of the strategic role of patrol aviation from a defensive coastal patrol to offensive long-range scout was the operational model of advanced sea basing. The contemporary generation of flying boats available to support the fleet in offensive scouting and strike required adequate seaplane tenders to sustain the aircraft from temporary advanced bases ahead of the main striking force. The Scouting Force had proven the concept of advanced base operations in Tactical Fleet Exercises as early as the 1920s. However, it took continual effort under the command of Commander, Aircraft Base Force, U.S. Fleet to refine the operational successes demonstrated in annual Fleet Problems and Tactical Fleet Exercises. By the end of 1936, the advanced basing construct had become a routine function of the VP wings.²⁸¹

Strategy and Technology Challenges

From 1930 to 1936, the Navy re-tooled its long-range Scouting Force to accommodate for the treaty tonnage restrictions placed on cruisers and submarines at the London Naval Conference. This required a larger dependence on naval aviation in general.²⁸² The tonnage restriction placed on aircraft carriers and cruisers by default put a physical limitation on the amount of shipborne aircraft that could be carried with the fleet on offensive scouting and strike operations. The treaty system, however, placed no limits

²⁸¹ Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1935 to 24 June 1936, 25, NARA, Annual Reports.

²⁸² Kuehn, *Agents of Innovation*, 52-55.

on the number of flying boats or seaplane tenders and naval leadership once again adjusted the strategic concept of how best to balance a sea-based striking force that could operate across the Pacific.²⁸³

By 1934, Op12 had developed plans that required long-range patrol aircraft to support the advance of the fleet through the central and western Pacific.²⁸⁴ However developmental prioritization through the late 1920s favored carrier aviation as the main component of the striking force of the fleet. This disparity in resourcing decelerated BuAer's solution to the technological challenge of developing a patrol plane with the range, endurance, and payload required to facilitate an active role in the current War Plan.²⁸⁵

The Vinson-Trammell Act (March 1934) authorized the Navy to build to the prescribed limits of the treaty system. However, the Navy was still in the process of re-adjusting its force structure to support the Orange War Plan within the confines of the latest restrictions placed upon it by the 1930 London Naval Conference.²⁸⁶ Long-range patrol aviation was still lagging strategically and technologically in both arenas of lighter-than-air and heavier-than-air.²⁸⁷ The problems regarding the strategic role and

²⁸³ "Facilities for Enlarged Aviation Program," 10 August 1934, NARA, PHGB, 1934, vol. 1, 108.

²⁸⁴ *Ibid.*, 102-105.

²⁸⁵ *Ibid.*, 95-98.

²⁸⁶ William F. Trimble, *Attack From the Sea: A History of the U.S. Navy's Seaplane Striking Force* (Annapolis, MD: Naval Institute Press, 2005), 14-15.

²⁸⁷ Annual Reports of Commander, Scouting Force U.S. Fleet to Commander in Chief, U.S. Fleet for the period 1 July 1932 to 15 May 1933, 11-12, NARA, Annual Reports.

technological reliability of patrol aviation faced by BuAer, and the Op12 were heard before the General Board in early 1934.²⁸⁸

Naval leadership in the form of the General Board, BuAer, Op12, and the command structure of the U.S. Fleet took the steps to transform the strategic, technological, and operational role of patrol aviation after the London Naval Conference. The developmental course of patrol aviation eventually gave way to the heavier-than-aircraft as the material solution to the strategic requirement for long-range aircraft. The demise of the lighter-than-air program and the eventual cancellation of rigid airship construction by 1935, allowed for more persistent and focused development of fixed-wing patrol aircraft at the technological and operational level.

At the time of the London Conference, the lighter-than-air program was in the process of being built from the ground up. By 1930, the future of the rigid airship program was uncertain due to the loss of the *Shenandoah* in September 1925. Despite the technological and operational difficulties, BuAer continued to advance the lighter-than-air program into the 1930s with the construction of two new rigid airships along with a new west coast air station in Sunnyvale, CA to support lighter-than-air scouting for the Battle Fleet in the Pacific.²⁸⁹

However difficult the way forward with respect to development of rigid airship technology, the standing naval policy was to “maintain as necessary the rigid airships now built and building and to determine their usefulness for naval and other government

²⁸⁸ “Facilities for Enlarged Aviation Program,” 23 July 1934, NARA, PHGB, 1934, vol. 1, 76-79.

²⁸⁹ “Aircraft Requirements for a Treaty Navy and Essential Auxiliaries,” 9 August 1933, NARA, PHGB, 1933, vol. 1, 78.

purposes, and their commercial value.”²⁹⁰ The pursuit of this policy was carried on beyond a reasonable doubt as to the overall determination of their usefulness. Admiral Joseph Mason Reeves, Commander in Chief, U.S. Fleet, testified before the General Board in August of 1934 about lighter-than-air policy sixteen months after the loss of the *Akron* off the New Jersey coast. The airship broke up in a storm in April of 1933 with the loss of seventy-three of seventy-six men. The Chief of BuAer, Admiral William Moffett was among those lost in the crash.²⁹¹ The only remaining operational rigid airship left in the Navy’s inventory was the USS *Macon* (ZRS-4), commissioned in June of 1933.

At the time of Reeves’ testimony the *Macon* was attached to the Commander, Aircraft, Battle Force and had participated in Tactical Fleet Exercises in the Caribbean that summer with mixed success.²⁹²

At one time I had hopes for lighter-than-air. I had visions of coordinating lighter-than-air with the heavier-than-air as an integral part of the Fleet. Those hopes have not developed and I do not see any prospects considering the limitations of the lighter-than-air. I see no prospect that they can ever form an integral part of the Fleet and maneuver and operate with the Fleet . . . I am afraid that the lighter-than-air is a very slender reed for the commander to lean upon for any purpose whatsoever,--intelligent work, scouting, or anything else. It is too much affected by conditions of weather and other things. . . . He [the commander] would never be justified in relying alone on the lighter-than-air doing a thing, because the certainty of its doing a thing does not exist. It may prove some use in patrolling the coast. It may have the fortunate coincidence of seeing something that is important, but if it ever sights an enemy combatant unit, it will have ceased its

²⁹⁰ “Facilities for Enlarged Aviation Program,” 14 August 1934, NARA, PHGB, 1934, vol. 1, 135-136.

²⁹¹ Vaeth, 96-100.

²⁹² “Facilities for Enlarged Aviation Program,” 14 August 1934, NARA, PHGB, 1934, vol. 1, 135-136.

value right then and there because it will have ceased to exist if it makes just that one report.²⁹³

This candid testimony suggests frustration with what seemed to be a program that was far from successful in the eyes of those who were husbanding the resources that developed it.

Reeves completed his testimony on lighter-than-air policy with substantive remarks that leave little room for interpretation as to the future of the rigid airship as a long-range scout for the fleet:

If you consider the money that is invested in lighter-than-air I think it a very long gamble compared with the same value in other units . . . for one dirigible at a cost of \$4,000,000 you could have 26 of these patrol planes so in that comparison as Commander in Chief of the Fleet if you should ask me whether I would rather have one dirigible or 26 patrol planes I would answer patrol planes.²⁹⁴

Reports of operations with *Macon* did improve from the time of Reeves' testimony but it was too little too late in terms of continuation of the rigid program.²⁹⁵ *Macon* was lost over the Pacific in February 1935 with only three of the eighty-three crewmembers killed. *Macon* had recently begun to carry lifejackets, which accounts for the high number of survivors; a lesson learned from the loss of the *Akron*.²⁹⁶ The parallel effort to bring lighter-than-air technology to the fleet proved too high a cost in men and material. The final setback with the loss of the *Macon* led to the cancellation of the rigid airship program by 1936.

²⁹³ "Facilities for Enlarged Aviation Program," 14 August 1934, NARA, PHGB, 1934, vol. 1, 136-137.

²⁹⁴ *Ibid.*, 137.

²⁹⁵ Annual Report of, Commander, Aircraft Battle Force, Commander in Chief U.S. Fleet for the period 1 July 1934 to 30 June 1935, 8, NARA, Annual Reports.

²⁹⁶ Vaeth, 100-101.

Photo # NH 97977 USS Akron approaches mooring mast, circa 1931-1933



Figure 6. USS *Akron* (ZRS-4) Approaches a Mooring Mast, circa 1932

Source: NavSource Naval History, Photo # NH 97977, “USS Akron approaches a mooring mast while landing, circa 1931-1933,” U.S. Naval History and Heritage Command, accessed 19 April 2015, <http://www.navsourc.org/archives/02/99/02990405.jpg>.

The Navy developed rigid airship technology for twelve years during the interwar period. The costs of building the infrastructure and industrial capacity for design and construction to the United States was an enormous undertaking considering the contemporary competition for resources, and political pressures of the day. However, Navy decision makers of the day had no idea what would succeed and what would fail, even though the contemporary interpretation of this path of development could be seen as

a blind alley. Had it been the only course of action that would have been the case—but to the Navy’s credit it was not.

The years following the London Conference mark the final departure from the Navy’s parallel effort to develop material solutions simultaneously. By 1935, heavier-than-air craft surpassed and eventually eclipsed the lighter-than-air solution. The General Board held a series of hearings following the authorization to build to treaty limits in 1934 by the Vinson-Trammell legislation. These hearings investigated the “facilities for an enlarged aviation program” focusing extensively on the newly prioritized role of patrol aviation from the perspective of the War Plans Division with respect to War Plan Orange.²⁹⁷

The General Board heard testimony from BuAer representatives on the impact of an increase in the number of patrol aircraft (to approximately 330), and their requisite infrastructure of personnel, bases, and tenders.²⁹⁸ This led back to discussions about the nature of the strategic role of developing an aircraft capable of long-range flight (3,000 miles).²⁹⁹ The General Board heard correspondence from the Chief of BuAer, Rear Admiral Earnest J. King, to the General Board in reference to General Board Memorandum 404 (Serial No. 1650-X) dated 7 August 1934. This memo consisted of a series of questions concerning the expansion of patrol aviation as a component of the full strength treaty navy authorized by the Vinson-Trammell Act:

²⁹⁷ “Facilities for Enlarged Aviation Program,” 10 August 1934, NARA, PHGB, 1934, vol. 1, 95-99; Kuehn, *Agents of Innovation*, 53.

²⁹⁸ “Facilities for Enlarged Aviation Program,” 10 August 1934, NARA, PHGB, 1934, vol. 1, 106.

²⁹⁹ *Ibid.*, 102-106.

Question 4: How does the Bureau of Aeronautics visualize the employment of patrol planes with the fleet as a striking force?

Answer: In a Pacific campaign the Commander-in-Chief would utilize every patrol plane available as a scouting and striking force. The number that would accompany the Fleet will depend upon the availability of bases and tenders. Between the West Coast and Hawaii, the entire area covered by the Fleet in transit could be patrolled by planes operating from the West Coast and Hawaii. In an advance beyond Hawaii planes basing at Pearl Harbor could patrol ahead of the Fleet for 1000 miles or more. As the Fleet advances farther to the westward, it would be necessary to establish island bases with the planes operating from tenders. . . . Planes operating from the Aleutian Islands, Pearl Harbor, Guam, Samoa, and other island bases could cover the entire Pacific area and detect the presence of the enemy.³⁰⁰

The BuAer vision of the role that patrol aviation would play in a Pacific naval campaign echoed the strategic concept of War Plan Orange. There existed a need for range-capable aircraft that could perform both offensive and defensive missions from “established island bases operating from tenders.”³⁰¹ This operational concept of advanced basing was refined and perfected in Tactical Fleet Exercises and Annual Fleet Problems while the VP squadrons were under the cognizance of the Base Force from 1933 to 1938.

The strategic requirement for patrol planes to operate defensively and offensively at ranges and carrying payloads beyond the technological capability of the current P2Y series aircraft called attention to how behind patrol aviation had fallen during the 1920s. BuAer, then under Admiral Earnest J. King, generated correspondence to the General Board to highlight this persistent developmental shortfall:

Question 11: Would it be wise to provide two types of patrol planes, one of short or moderate range for District use [defense of Naval Districts 14/15

³⁰⁰ “Facilities for Enlarged Aviation Program,” 10 August 1934, NARA, PHGB, 1934, vol. 1, 105.

³⁰¹ Ibid.

Hawaii and the Panama Canal Zone], and one of the longest possible range for Fleet use [offensive long range scouting]?

Answer: The Bureau does not believe it would be wise to have two types of patrol planes for District use and for Fleet use. . . . Patrol planes are a powerful striking force; they are not limited in number by Treaty as are carrier planes. In every fleet problem, whether the patrol squadrons were used in defense or in offense, this short range has been as serious handicap. It is believed to be a function of the Fleet to protect convoys and keep sea-lanes open. Patrol planes of a long endurance will be invaluable in accomplishing this mission. . . . The bureau believes that the development of long-range patrol planes, capable of carrying heavy bomb loads, should proceed as expeditiously as possible.³⁰²

King's correspondence suggests the urgency of the material solution that BuAer was pursuing with respect to the strategic dilemma created by the role of VP in aerial defensive patrol of the districts versus offensive scouting in support of operations at sea.

The struggle through the material difficulties of the PN/P2Y series aircraft prior to the Vinson-Trammell Act was in large part due to naval leadership focus on resourcing its aviation design and construction efforts in favor of carrier aviation. Commander A. D. Bernhard (BuAer) testified before the board in August 1934 on the prioritization of resources that BuAer had historically allocated to patrol plane development prior to the Vinson-Trammell Act.

I would like to say a word about planes. In the thousand plane allowance which we have had since 1926 we were allowed a large number of patrol planes. However, when new ships were put into commission they did not authorize any planes for them, but cut down the patrol planes and built carrier and cruiser planes instead. That is why our patrol plane program is behind. We are trying to catch up.³⁰³

³⁰² "Facilities for Enlarged Aviation Program," 10 August 1934, NARA, PHGB, 1934, vol. 1, 108.

³⁰³ *Ibid.*, 110.

Bernhard's statement is testament to the low priority that patrol aviation was given through the late 1920s because of carrier aviation acquisitions. The PN and P2Y series flying boats that represented the second-generation heavier-than-air craft program were so hampered by material deficiencies that by the 1930 London Conference, the struggle to develop advanced basing in even a defensive role was conceptual at best.³⁰⁴



Figure 7. P2Y-3, circa 1935

Source: Dan Shumaker Collection, No. 6242, "Consolidated 22 P2Y-3 (9570) U.S. Navy," Source unknown, 1000AircraftPhotos.com, accessed 19 April 2015, <http://1000aircraftphotos.com/Contributions/Shumaker/6242.htm>.

³⁰⁴ Miller, *War Plan Orange*, 176.

The urgency to develop heavier-than-air patrol aviation in the first half of 1930s resulted in the successful design and production effort of the PBV Catalina. In October 1933, BuAer contracted the Consolidated and Douglas Aircraft Corporations to design and build prototypes that could replace the P2Y series flying boats.³⁰⁵ The result was the XP3Y-1 and the XP3D-1 the designation “Y” and “D” denoted the manufacturers Consolidated and Douglas respectively.³⁰⁶ Initial test flights were completed by March 1935 and Consolidated won the BuAer production contract by undercutting the unit cost to \$90,000 apiece.³⁰⁷ By June of that year, the production orders were formalized for sixty of the newly designated PBV-1 (Patrol Bomber).³⁰⁸ Refinement of the design continued and subsequent variants of the PBV series continued to roll off the production line at the newly opened plant in San Diego, CA.³⁰⁹

Because of the large appropriations authorized by the 1934 Vinson-Trammell Act, the Navy placed orders for 110 PBV variants in 1936 alone.³¹⁰ From 1936 to 1939, BuAer was able to sustain the patrol wings of the U.S. Navy with enough PBV replacement aircraft to both replace the obsolete force of P2Ys while simultaneously

³⁰⁵ E. R. Johnson, *American Flying Boats and Amphibious Aircraft*, 94-95.

³⁰⁶ *Ibid.*, 97.

³⁰⁷ *Ibid.*

³⁰⁸ Swanborough and Bowers, 8. In March 1934 the Navy transitioned to a new two letter type/class designation system to denote dual purpose aircraft types like the PBV.

³⁰⁹ Swanborough and Bowers, 95-96.

³¹⁰ *Ibid.*, 96.

increasing the number of VP squadrons in the fleet by two per year.³¹¹ CinCUS, Admiral Claude C. Bloch reported in 1938 on the strength and state of replacement with regard to the current patrol aviation force for the year:

During the fiscal year obsolete patrol planes have been for the most part retired and new airplanes have been assigned to operating squadrons. By 1 December 1938 twenty squadrons will be in commission with P2Y and PBY airplanes...In general, the patrol planes and power plants procured for the Scouting Force are satisfactory, with characteristics and material condition excellent for the conduct of assigned missions with the fleet. Delays have been experienced in connection with providing de-icing equipment and automatic flight controls though this should be rectified in the near future.³¹²

The aggressive procurement and replacement schedule is an indicator of the urgency with which naval leadership was trying to modernize fleet patrol aviation. The comment concerning the delays in the autopilot and de-icing equipment speaks to the leaps in engineering that advanced during the development of the PBY Catalina.

The efforts of BuAer, Consolidated, and the leadership of the U.S. Fleet share the credit for the material creation of the modernized force of patrol bombers that the Navy developed from 1933 onward. A combination of strategic necessity and material technological development enabled the transformation of patrol aviation into a defensive and offensive airborne scouting and striking force. However, the physical presence of a strategic capability was worthless without the appropriate tactical and administrative organization to employ it at sea.

³¹¹ Annual Reports of Commander in Chief, U.S. Fleet for the period 1936-1940, NARA, Annual Reports.

³¹² Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1937 to 30 June 1938, 17, NARA, Annual Reports.

Organizational and Tactical Developments in the Wake of the London Naval Conference

While naval leadership and the civilian aircraft industry balanced the refinement of strategic role with the technological capability of patrol aviation, the operational fleet commanders were actively shaping a suitable organizational construct for the units that were to operate the aircraft themselves. A distinction between administrative versus tactical command had to be established.

Prior to 1933, VP squadrons served with both the Battle Force on the west coast of the United States and the Scouting Force on the east coast of the United States. This organization led to a decade of non-standardized development and lopsided resourcing. On 1 April 1930 the CinCUS, Admiral Richard H. Leigh, abolished the command of Aircraft Squadrons, Scouting Force, and established the new command Aircraft Squadrons, Base Force.³¹³ The decision placed all the VP squadrons in the Navy under the control of a single commander. This included squadrons based in Fleet Air Bases Coco Solo, Canal Zone and Pearl Harbor, Territory of Hawaii.

The 1933 reorganization allowed for an administratively pure formation solely constituted by VP units poised for an aggressive material expansion. The organizational isolation allowed for the Base Force innovate and nurture the expansion of obsolete units into effective wings of modern long-range flying boats. By 1 October 1937, the fully expanded VP wings, equipped with the PBY Catalina, were re-integrated back into the

³¹³ Annual Reports of Commander, Scouting Force U.S. Fleet to Commander in Chief, U.S. Fleet for the period 1 July 1932 to 15 May 1933, 7, NARA, Annual Reports.

Scouting Force for offensive scouting.³¹⁴ The strategic concept of patrol aviation as a long-range information-striking force had been forged by five years of tactical, operational, and administrative development in the Base Force.

Prior to the 1933 reorganization of VP into the Base Force, the technological limitations of range and endurance of the P2Y aircraft precluded VP squadrons from extended sea operations with the fleet.³¹⁵ VP squadrons were therefore more tactically suited to coastal patrol duty. However, due to the centralized organization under command of the Base Force, VP squadrons were able to formalize tactical doctrine and standardize operations.

Another area that the 1933 re-organization affected in order to transition VP squadrons to an information-striking force was the creation of an administrative foundation. Having VP squadrons under the cognizance of a single command allowed the Base Force to effectively balance the process of a material expansion in manpower and equipment. By centralizing the authority of the Base Force, naval leadership set the conditions for key developments required to standardize patrol aviation into an effective combat force.

The Navy did not yet have a long-range patrol aircraft that could operate routinely with the fleet from advanced bases. However, by 1933, the material capability of the

³¹⁴ Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1937 to 30 June 1938, 2, NARA, Annual Reports.

³¹⁵ Annual Reports of Commander, Scouting Force U.S. Fleet to Commander in Chief, U.S. Fleet for the period 1 July 1932 to 15 May 1933, 11-12, NARA, Annual Reports.

PBY Catalina was in development and its procurement was expected by 1936.³¹⁶ Fleet leadership recognized that the material expansion of the force would necessitate a centralized administrative authority to manage the transition and standardize the organization. This expansion occurred while the fleet was still flying the P2Y and assumed a significant amount of organizational risk considering the Navy still did not physically have the material capability to perform the required mission set.

Prior to the reorganization under the Base Force construct, the P2Y series flying boat had significant material defects that plagued its operational usefulness. The Navy's second-generation heavier-than-air long-range patrol aircraft was deficient enough to curtail its utility for the fleet as a long-range scout.³¹⁷ Vice Admiral Frank H. Clark of the Scouting Force reported on the material deficiency of the P2Y type patrol plane in his annual report to the CinCUS:

This force is equipped with patrol planes of the PM-2, P2Y, and PH-1 types. Considerable structural difficulty has been encountered with these, notably with the tail surfaces of the P2Ys. The R-1820 engines are undependable and limit the safe range of operating these planes. Their speed is much too slow and their range of action insufficient. Patrol planes should have a cruising speed of approximately 150 knots and fuel for about 24 hours. In general there have been too many structural and material failures in the patrol planes. It is hoped that better types of these planes and more rugged engines are in the process of development. The performance of all types of aircraft must be improved and this improvement must be continual and constant. The patrol planes probably are lagging farthest behind in development at present.³¹⁸

³¹⁶ Annual Reports of Commander, Fleet Base Force to Commander in Chief, U.S. Fleet for the period 1 July 1935 to 24 June 1936, 13, NARA, Annual Reports.

³¹⁷ Miller, *War Plan Orange*, 176.

³¹⁸ Annual Reports of Commander, Scouting Force U.S. Fleet to Commander in Chief, U.S. Fleet for the period 1 July 1932 to 15 May 1933, 11-12, NARA, Annual Reports.

The inability to extend the range or endurance of the P2Ys kept VP squadrons tied to fleet bases. This explains the large numbers of VP squadrons in Fleet Air Base Pearl Harbor and Coco Solo (four squadrons in each base).³¹⁹ Because of this, the squadrons could only develop coastal patrol tactics and any scouting past approximately 400 miles required tender support for advance base operations.

Advanced base operations were also difficult to perform due to the lack of adequate tenders. The USS *Wright* (AV1) was the first and only purpose built tender in the fleet at the time. The remaining six tenders were converted Bird-class minesweepers.³²⁰ Despite the operational difficulties brought about by the inadequate aircraft and tenders, the centralization of command offered by the organization under the Base Force allowed for patrol aviation to make forward progress through the first half of the 1930s. The CinCUS Admiral David F. Sellers reported in 1934 after the VP squadrons had been under the command of the Base Force for its first full year:

Patrol squadrons have been operated very aggressively during the year and have shown marked progress. It has been emphasized that the squadrons at Coco Solo and Pearl Harbor are Fleet units and have been operating as such. Advanced base operations have been conducted on a more extensive scale than previously and certain defects have been noted and corrected. . . . The *Wright* is believed to be of considerable value as a tender and fulfills its functions very well considering its speed. Tender facilities and the Fleet Air Bases at Coco Solo and Pearl Harbor are not sufficient to permit advanced base operations of all squadrons simultaneously.

³¹⁹ Ibid., 2-3.

³²⁰ Annual Reports of Commander, Base Force U.S. Fleet to Commander in Chief, U.S. Fleet for the period 1 July 1933 to 10 May 1934, 8. NARA, Annual Reports. The six Bird class minesweepers converted to aircraft tenders assigned to the base force were the USS *Teal* and *Lapwing* to the Fleet Air Base (FAB), Coco Solo; the *Pelican* and *Avocet* to the FAB, Pearl Harbor; and the *Sandpiper* and *Gannet* to the Base Force Aircraft Units at San Diego, California.

This can be accomplished only when Wright is present. The lack of satisfactory tender facilities at these bases has been keenly felt.³²¹

The report points to the fact that advanced base operations needed to fulfill the strategic war plans requirement to perform offensive scouting was still a work in progress by 1934. The operational shortcomings lay with the unreliability of the P2Y aircraft and the limitations of contemporary seaplane tenders. Both of these factors hampered the mobility of the patrol squadrons until the first PBVs were put to sea in 1936.³²²



Figure 8. USS *Wright* Tending a P2Y Seaplane at Cuba, circa 1937

Source: NavSource Naval History, "USS *Wright*, 1936-1938," Photo by Albert Weigandt F1c, courtesy James Card QMC, USN, accessed 19 April 2015, <http://www.navsource.org/archives/09/41/09410108.jpg>.

³²¹ Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1933 to 15 June 1934, 24-25, NARA, Annual Reports.

³²² Miller, *War Plan Orange*, 176.

Because of their struggle with material inadequacy, the VPs could only routinely sustain short-range defensive missions from established bases. All the while, *Macon* was still being evaluated for long-range fleet work. In 1933, Admiral Sellers reported on the tactical and operational progress of the last remaining rigid airship in the Navy's inventory:

The *Macon* has participated in all Fleet Tactical Exercises, including the Fleet Problem, since her arrival at Sunnyvale. Much valuable information has been obtained pertaining to its operations and will be forwarded to the Department in a separate correspondence.³²³

The fact that *Macon* was attached to the Aircraft Squadrons, Battle Force and the VP squadrons were attached to the Base Force denotes a distinction on the part of the Commander-in-Chief as to the perceived strategic roles of the two aircraft types.

In August 1934, the General Board heard correspondence (General Board Memorandum 404) from the Chief of BuAer, Admiral Earnest J. King. The statements relate to the question of fleet reorganization that proposed to create a Fleet Air Force:

The organization of the Fleet Air Force has, in the opinion of the Commander-in-Chief [then ADM Joseph M. Reeves], the following advantages:

- (a) It approaches closer to the probable tactical organization of the Fleet in war.
- (b) It groups all aircraft, including the patrol squadrons, in one command. It makes the patrol squadrons offensive, combatant arms of the Fleet, as they should be.
- (c) It avoids operating the patrol squadrons through Commander Base Force, who generally is not a tactical commander. The assignment of the patrol squadrons to the base force implies a defensive role on their part, which is not correct.³²⁴

³²³ Miller, *War Plan Orange*, 176.

³²⁴ "Facilities for Enlarged Aviation Program," 10 August 1934, NARA, PHGB, 1934, vol. 1, 103-104.

The testimony illustrates the shift in strategic role that the Navy assigned to patrol squadron and how the leadership might effectively organize the fleet to both administratively develop and then tactically employ the force in war. King's written statement suggests that the home that patrol aviation found in the Base Force was always meant to be a temporary arrangement.

Patrol aviation continued to operate as an experimental placeholder in the overall strategic picture for long-range offensive scouting as it developed standardized tactics and operational doctrine into the mid-1930s. The unity of the Base Force advanced the standardization and development of tactical publications, procedures, and communications, despite the geographic distance between the command components.

Admiral Frederick. J. Horne, Commander of the Base Force, U.S. Fleet, reported on the organization of the patrol squadrons in 1934:

The present organization of the Aircraft Base Force, comprising as it does, three major subdivisions, which are widely separated geographically, entails administrative difficulties not normally encountered with a force of its size. However, these difficulties are more than balanced by the fact that the organization affords a means of standardizing the training and indoctrination of all patrol squadrons to a degree that would be difficult to attain with another organization.³²⁵

Horne's report testifies to the centralizing quality of the Base Force on the organizational development of the VP squadrons as they begin to standardize their training and tactics.

The VP squadrons were aligned in an administratively pure organization in order to achieve tactical, operational, and material homogeneity in a deliberate attempt to manage

³²⁵ Annual Reports of Commander, Base Force, U.S. Fleet to Commander in Chief, U.S. Fleet for the period 1 July 1933 to 10 May 1934, 2, NARA, Annual Reports.

the formalization of the patrol plane force as it transitioned to its new role of offensive fleet scout.

The central administrative organization of the Base Force served the expansion of the VP squadrons based in San Diego, Coco Solo, and Pearl Harbor into respective wings by the year 1935.³²⁶ The component commands were geographically separated but the centralized administration under the Base Force created the conditions whereby the organization could standardize tactics, material, communications, and procedures. Horne further reported on advances made in the standardization of tactical publications and training:

New methods have been developed and the work of the squadrons based at San Diego, Coco Solo, and Pearl Harbor, have been standardized and coordinated by the Base Force. Tactical instructions covering scouting, patrol, navigation, communication and operations of planes from tenders at advanced bases . . . Commander, Aircraft Base Force, in Wright, visited the Midway Islands on 14-15 February, and French Frigate Shoals on 18 February. This operation was initially planned in connection with a patrol plane flight from Pearl Harbor to the Midway Islands. Unfavorable weather resulted in the cancellation of the aircraft operations but much valuable information was obtained as a result of the Wright's visit.³²⁷

Horne's report highlights the efforts of the Base Force to standardize the patrol squadrons above just the unit level. The coordinated operations with the visit of the *Wright* to the northwestern reaches of the Hawaiian Islands also shows a deliberate emphasis on development of the strategic capability to conduct advanced base operations west of Pearl Harbor. Even flight meals were standardized under cognizance of the Base Force in 1934. As the long missions that typified patrol plane sorties became routine operations a

³²⁶ Annual Reports of Commander, Base Force, U.S. Fleet to Commander in Chief, U.S. Fleet for the period 1 July 1934 to 30 June 1935, 7, NARA, Annual Reports.

³²⁷ *Ibid.*, 10.

“cruising ration for seaplanes on extended flights was recommended and approved;” this cruising ration was “considerable improvement on the former method of furnishing fruit and sandwiches from the general mess.”³²⁸

Base Force administration also leveraged outside sources of experience in the relatively new field of aerography. In 1935, Commander Base Force reported on advances made in the standardization of weather data for aviation over long distances:

Valuable weather data was obtained during the past year from Pan-American Airways, Alaskan Signal Corps stations, various Alaskan Canneries and Canadian Direction finder and traffic stations. If provision has not been made it is considered necessary that mobilization plans take care of the ready utilization of such above activities as may be practical in case of war.³²⁹

From 1933 to 1938, patrol aviation experienced an exponential pace of material expansion. While under the administrative authority of the Base Force, VP strength was increased from seven VP squadrons totaling seventy-two aircraft in 1933, to a force sixteen squadrons operating 204 aircraft by 1937.³³⁰ BuAer had also completed contracts for the Department of the Navy for 170 more PBY variants from the Consolidated Aircraft Company in San Diego that same year.³³¹

The Base Force managed the rapid replacement of the P2Y series patrol planes for the PBY Catalina. A disciplined incremental replacement schedule helped bring the PBY to the fleet starting in 1936. The Aircraft Base Force Stores Office, placed in commission

³²⁸ Annual Reports of Commander, Aircraft Base Force to Commander in Chief, U.S. Fleet for the period 1 July 1933 to 10 May 1934, 24, NARA, Annual Reports.

³²⁹ *Ibid.*, 8.

³³⁰ Annual Reports of Commander, Aircraft Base Force to Commander in Chief, U.S. Fleet for the period 1 July 1936 to 30 June 1937, 1-3, NARA, Annual Reports.

³³¹ *Ibid.*, 17.

on 1 October 1936, was the accounting and procurement agency of the Aircraft Base Force.³³² The Stores Office provided for incremental retirement of obsolete airframes and handled the commissioning of new squadrons. Throughout the expansion, the Stores Office “effected deliveries and transfers of airplanes, obtaining special equipment and materials put into execution with a minimum of disruption to regular affairs.”³³³

The leadership of the Base Force ably managed an administrative tidal wave of requirements that accompanied the manning training and equipping of so many new units as this Fleet Commander-in-Chief report highlights:

The supply of material is not considered entirely satisfactory. Excess paper work and duplication of effort is required in the commissioning and equipping of new PBV patrol planes when received from the contractor. The Aircraft Base Force Stores Office, placed in commission on 1 October 1936, has served most useful purpose. This office acts as a procurement agency in the commissioning of PBV patrol planes received directly from the contractor at San Diego, and without the services of this activity the necessary accounting incidental to maintaining records for all Aircraft Base Force in the United States would have presented magnified complications. This office has relieved the main tenders from all paperwork concerned with squadron procurement of material and accounting records. The above mentioned activity has served the ferry plane detachments during the commissioning period, and resulted in the squadrons from the various Fleet Air Bases being fully commissioned and serviced prior to their departure to their home base. The process of requiring the Wright to act as accounting and procurement agency for patrol planes was outgrown during the expansion program of the Aircraft Base Force.³³⁴

Some historians theorize that the five-year period between 1933 and 1938 when patrol aviation was assigned to the Base Force had negative, even punitive attributes. However,

³³² Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1936 to 30 June 1937, 16, NARA, Annual Reports.

³³³ Ibid.

³³⁴ Ibid.

evidence suggests that from strategic, operational, and technological perspectives, the period contained unprecedented developmental growth.³³⁵

As the patrol aviation progressed and expanded through the second half of the 1930s a debate for the future reorganization of naval airpower raged in the General Board and in the highest echelons of the U.S. Fleet. The technologically superior PBY Catalina and the operational concept of advanced-basing increased the strategic value of the VP squadrons such that they now approached the capability originally required by the War Planners inside OpNav.

Would VP remain under control of the Base Force or transition to the combat-focused element of the fleet where its emerging role as an offensive long-range fleet scout could be better exploited? CinCUS, Admiral Arthur J. Hepburn, suggested the reorganization of the fleet into type commands for administrative purposes.³³⁶ These type commands could also be developed in peacetime and easily broken up into modular tactical task forces and task groups in time of war. He proposed placing all of the aviation units into a Fleet Air Force, which would have taken VP from the Base Force:

Fleet Air should include all Fleet aircraft, except airplanes assigned to battleships and cruisers, and utility airplanes assigned to the Base Force. Fleet Air should include all aircraft carriers, all carrier based planes, and all Fleet patrol planes with their tenders. It is essential that the Fleet patrol planes be removed from the Base Force, immediately, and placed in the Fleet Air Force it is not part of the Fleet Base Force mission to participate in the combatant work of the fleet. On the other hand, the Fleet patrol planes have no other mission. They are a vital part of

³³⁵ Miller, *War Plan Orange*, 176-177. Miller claims that the 1933 detachment of the VP squadrons from the Scouting Fleet took patrol aviation from the “power centers of the fleet, and banished them to a new command, Aircraft, Base Force, for stodgy defensive patrols of bases.”

³³⁶ Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1936 to 30 June 1937, 12-13, NARA, Annual Reports.

the combatant units of the Fleet; they must come under the direct command of the fleet Air Force Commander for training and operation.³³⁷

Hepburn's report indicates that by 1936, naval leadership viewed the patrol plane force of VP wings as having developed the requisite tactical and operational capabilities to re-integrate with the fleet in an offensive role.

The 1937 Base Force Report to Admiral Hepburn alludes to the fact that the Patrol squadrons had developed into a force whose expanded offensive role required re-organization in order to facilitate its appropriate employment with the fleet.

The patrol plane units of the fleet have expanded into a powerful long-range patrol-bombing force of great value to the fleet. It is self-evident that they are misplaced in the Base Force both as their designed functions, capabilities and employment.³³⁸

By 1937, the VPs were re-organized under cognizance of Commander, Aircraft Scouting Force, U.S. Fleet. By this time, the VP transition to the PBY Catalina was well underway. VP aircraft were routinely ferrying replacement aircraft from San Diego to Pearl Harbor and were able to maintain radio communications for over 1,000 miles in transit.³³⁹ The PBYs had also “demonstrated their abilities to remain on tracking missions for some thirty hours;” twice the amount of endurance as their P2Y predecessors.³⁴⁰

³³⁷ Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1936 to 30 June 1937, 12-13, NARA, Annual Reports.

³³⁸ Annual Reports of Commander, Aircraft Base Force to Commander in Chief, U.S. Fleet for the period 1 July 1936 to 30 June 1937, 3, NARA, Annual Reports.

³³⁹ *Ibid.*, 8, 12.

³⁴⁰ *Ibid.*, 8.



Figure 9. Consolidated 28-2 PBY-2 Catalina, 1937

Source: Ray Crupi Collection, No. 10472, “Consolidated 28-2 PBY-2 Catalina (0454) U.S. Navy,” Photograph from consolidated taken at San Diego, CA, 15 May 1937, 1000AircraftPhotos.com, accessed 19 April 2015, <http://1000aircraftphotos.com/Contributions/CrupiRay/10472.htm>.

Placing the patrol squadrons under a centralized command structure in 1933 allowed for standardization of tactics and training of a skeleton force dispersed over a wide geographic area. The administrative authority of the Base Force also allowed the patrol wings to achieve an aggressive but efficient transition to the PBY Catalina. The result was that by 1937 the Base Force had expanded the patrol wings into an efficient organization of tactically standardized units equipped with the most modern patrol planes in the world. However, the strategic capability to perform long-range scouting and strike missions was not an end in and of itself. Patrol aviation had to be integrated back into the appropriate operational echelon of the fleet in order to maximize its full tactical potential.

The venue for this re-integration were the Fleet Tactical Exercises and Annual Fleet Problems.

Operational Refinement of Patrol Aviation:
Fleet Exercises and Annual Fleet Problems

The herculean innovative effort by the naval leadership to re-equip, reorganize, and standardize patrol aviation following the London Naval Conference satisfied the War Plan Orange strategic requirement for a force of long-range offensive information-strike aircraft. However, it was the operational concept of advanced basing that allowed for the patrol squadrons to apply their hard-earned tactical and technological advantages to fulfill in their newly conceived role. Even the PBY Catalina with 2,500 mile plus range required the support from aircraft tenders in order to operate from the remote island positions in advance of the fleet. For the patrol squadrons of the Base Force, the forum for operational integration and standardization of advanced-basing were the Tactical Fleet Exercises and annual Fleet Problems.

Tactical Fleet Exercises were a series of smaller unit maneuvers, which built upon one another and culminated in a grand coordinated fleet battle scenario called the Annual Fleet Problem. The U.S. Navy conducted twenty-one Fleet Problems during the interwar period and it was here that patrol aviation refined the operational component of offensive long-range aerial scouting for the fleet.³⁴¹

The Base Force spent 1933 to 1936 routinely exercising the advanced base concept utilizing obsolescent P2Y aircraft and unimproved seaplane tenders of the converted Bird-class minesweepers. By 1936, the Base Force had achieved its goal of

³⁴¹ Nofi, 94.

standardizing this enabling operational concept for patrol plane squadrons. This set the conditions whereby the aggressive procurement and expansion program surrounding the introduction of the PBY Catalina served simply as a force multiplier to an operational framework that had already been validated at sea.

By June 1936, the advanced base operations were routine and effective enough to apply the concept in Fleet Problem XVI. Though later Fleet Problems more fully exploited the capabilities of the PBY Catalina and follow-on improvements for seaplane tenders, it was during Fleet Problem XVI that the strategic concept of advanced based aerial fleet scouts crystalized at the operational level.

Patrol plane integration with the fleet was refined by the operational concept of mother ship developed in the 1920s by the Scouting Fleet. Pairing flying boats with seaplane tenders highlighted the expeditionary nature of patrol aviation long-range capability for the aircraft to operate in an offensive role with the fleet, independent of advanced land bases.³⁴² Recall that land bases could not be developed in the western Pacific because of the Washington Treaty's Fortification Clause. Once the newer P2Y aircraft were present in sufficient numbers, they were incorporated into the scripts for the annual Fleet Problems. The Base Force aggressively exercised advanced base operations from 1933 in order to promote experience and find working solutions to the inadequacies of the tenders, and P2Y aircraft.³⁴³ By 1935, VP proficiency in advanced base operations continued to improve to the point where the CinCUS was able to operate VP squadrons in

³⁴² Miller, *War Plan Orange*, 176-177.

³⁴³ Annual Reports of Commander in Chief, U.S. Fleet from 1933 to 1938, NARA, Annual Reports. All Annual reports from the Base Force or CinCUS contain some reference to patrol squadrons conducting advanced base operations.

relatively large numbers from remote advanced bases in the central and northern Pacific.³⁴⁴

The scenario for Fleet Problem XVI (April to June 1935) combined the largest fleet maneuvers ever held in the Pacific. Bound by the Aleutian and Hawaiian island chains and the west coast of the United States the theater of the exercise covered some five million square miles of ocean and included five task forces and nearly 500 aircraft.³⁴⁵ The architect of the scenario was the CinCUS Joseph Mason Reeves. The scope of Fleet Problem XVI was the first of its kind to be held on a truly strategic scale.³⁴⁶ The 1935 report from the CinCUS, Admiral Reeves, summarizes the participation of the VP squadrons task organized to the fleet during Fleet Problem XVI

29 April to 10 June 1935:

During Fleet Problem XVI, 48 patrol planes departed from Pearl Harbor for Midway, three planes were forced to return to Pearl Harbor, but the 45 planes operated from Midway during Fleet Problem XVI. Between 17 July and 4 September advanced base exercises were carried out in south and southeastern Alaskan waters by VP Squadrons 7 and 9. These latter squadrons operated in Alaskan waters again during Fleet Problem XVI. During January and February VP Squadrons 2, 3, 5 operated in the Caribbean. The following localities, which, so far as known, have not been visited previously by naval aircraft squadrons, were used during advanced base operations during the year:

Atlantic and Caribbean Area: Cartagena Colombia; Curacao D.W.I.; Maracaibo, Venezuela; Port of Spain, Trinidad; Guadeloupe and Martinique, F.W.I.; ST Vincent, B.W.I. San Juan, P.R. and Samana Bay, D.R.

Pacific Area: Humboldt BA, CA; Portland OR; Vancouver and Prince Rupert, B.C.; Sitka, Juneau, Ketchikan, Cordova, Seward, Kodiak, Dutch Harbor,

³⁴⁴ Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1934 to 30 June 1935, 20-21, NARA, Annual Reports.

³⁴⁵ Nofi, 110.

³⁴⁶ Ibid.

and Lituya Bay Alaska; Humboldt Harbor, Shumagin Islands; False Pass, Unimak Island; Nazan Bay; and Kuluk Bay. Also, Midway Island, in the Hawaiian Island Group.³⁴⁷

The sheer number of advanced bases that the patrol squadrons operated from in 1935 suggests a high level of proficiency. Reeves' report of the patrol squadron's performance in the Fleet Problem XVI scenario is validation that advanced basing was an operational reality. However, due to material difficulties in tenders, advanced base operations were still not considered routine.

For Fleet Problem XVI, the forty-five patrol planes at Midway were supported by two Bird-class tenders whose capacity for aviation gasoline was only 10,000 apiece.³⁴⁸

Admiral Alfred Wilkinson Johnson testified before the General Board on 6 July 1936 on the characteristics of minesweepers and light seaplane tenders. His remarks were in reference to his experience commanding the patrol squadrons during Fleet Problem XVI:³⁴⁹

We were operating 45 planes. Two mine sweepers and two big motor launches and we were using 13,000 gallons of gas a day. . . . They [the patrol planes] were continually re-servicing, night and day. They would go out, and as they would come back at different times . . . and with the arrangements we had four re-fueling points. . . . They would send the planes out one day and come back late that night and have to go out the next day for two to three days, and then probably overhaul. . . . We couldn't have kept our Midway Island performance up any longer. We were just going every day and if we had to continue for two days more we would have had to stop operations. In a war you have to keep going all the time.

³⁴⁷ Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1934 to 30 June 1935, 20-21, NARA, Annual Reports.

³⁴⁸ "Aircraft Building Program-1937," 5 October 1936, NARA, PHGB, 1937, vol. 2, 308-309.

³⁴⁹ "Minesweepers and Light Seaplane Tenders—Characteristics of," 6 July 1936, NARA, PHGB, 1936, vol. 1, 114-132.

Johnson is referencing a particular phase of Fleet Problem XVI that took place from 15 May to 23 May.³⁵⁰ The testimony calls attention to the fact that advanced basing with the Bird-class minesweepers was severely limited by their fuel capacity and the overhaul cycle of the aircraft themselves. Though aircraft reliability improved with the PBY Catalina, the tender limitations were not solved until after 1938. This limited advanced base operations to a finite period of useful operations depending on the intensity of flight operations.³⁵¹ In the case of Fleet Problem XVI, this period was approximately two weeks.

³⁵⁰ Nofi, 111-112.

³⁵¹ “Minesweepers and Light Seaplane Tenders—Characteristics of,” 6 July 1936, NARA, PHGB, 1936, vol. 1, 125. The Board discussed the requirements of a replacement tender that was comparable to the USS Wright (65,000 gallon aviation gas capacity). This capacity was estimated to “support operations of a 12 plane squadron for 11 days.”

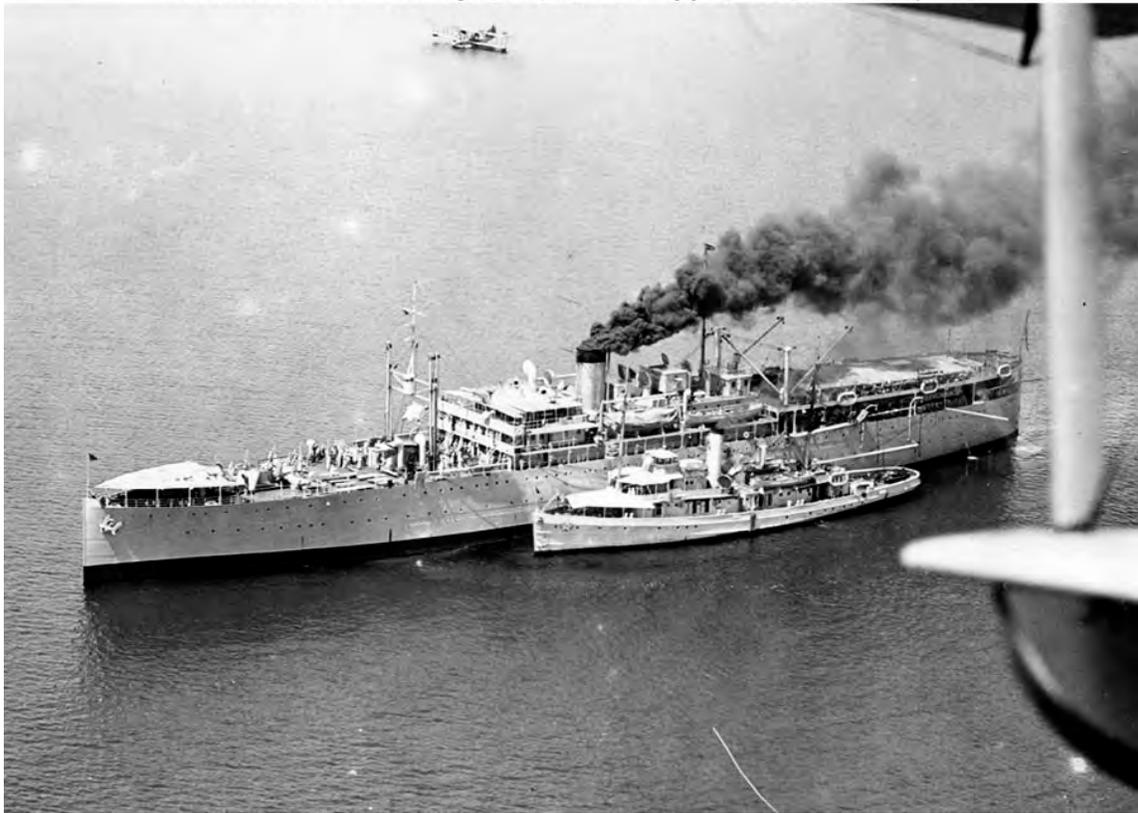


Figure 10. USS *Wright* (AZ-1) with USS *Sandpiper* (AM-51 later Redesignated AVP-1) Alongside, circa 1923

Source: NavSource Naval History, Photo # NH 100449, “USS *Wright* (AZ-1) and USS *Sandpiper* (AM-51) circa February 1923,” Mike Green, U.S. Naval History and Heritage Command, accessed 19 April 2015, <http://www.navsource.org/archives/11/110205109.jpg>. Note the difference in size of the smaller Bird-class tender.

The aggressive push for patrol squadrons to standardize advanced base operations acutely aggravated the problem of suitable aircraft tenders. During the majority of the interwar period, the VP squadrons of patrol planes operated with only a single purpose built tender, the USS *Wright* (AV1). From 1934 to 1937, the remaining six were of the converted Bird-class minesweepers. The USS *Teal* and *Lapwing* at the Fleet Air Base Coco Solo; *Pelican* and *Avocet* at the Fleet Air Base Pearl Harbor; and *Sandpiper* and

Gannet at the Fleet Air Base in San Diego. The converted minesweepers were deficient in speed, repair facilities, berthing space and storage for aviation gasoline.³⁵² Chief of BuAer, Rear Admiral Arthur Byron Cook testified before the General Board in October 1937 concerning the smaller Bird-class minesweepers:

I think the requirements recommended by War Plans are five large and 12 small tenders. The five large would take care of ten squadrons and the small would take care of 12. That is 22. The large proportion of tender basing that is now practicable is provided by small tenders, converted from "bird" class minesweepers, which carry 10,000 gallons of gasoline. When you consider that a single modern patrol plane carries 1750 gallons of gasoline it does not take much imagination to see how totally inadequate 10,000 gallons is for even the refueling of a squadron of these planes. Their speed is very limited and their hoisting capacity is limited. The facilities for repairing - all of that is limited. I feel strongly that until we get sufficient modern tenders to carry out proper peacetime training we won't be as well prepared to carry out these missions in war.³⁵³

This observation from BuAer inspired an improvement program to convert four destroyers to seaplane tenders by 1939.³⁵⁴

The fleet relied heavily upon *Wright* during this period; it was the only purpose-built tender operating with the Base Force. The Commander Base Force U.S. Fleet reported on the deficiency and the heavy reliance on the *Wright* to support increased operational tempo of the patrol squadrons in 1935:

In order to conduct advanced base operations at Coco Solo and Pearl Harbor, on a satisfactory scale, it is at present necessary that *Wright* participate in such exercises which usually results in Commander Aircraft Base Force and that vessel being absent from the fleet for a considerable period each year. In operations with patrol Squadrons, *Wright* has steamed over 60,000 miles in the past two years.

³⁵² "Aircraft Building Program-1937," 5 October 1937, NARA, PHGB, 1937, vol. 2, 308-309.

³⁵³ *Ibid.*

³⁵⁴ Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1936 to 30 June 1937, 14-15, NARA, Annual Reports.

Tender facilities at each Fleet Air Base should be capable of supporting squadrons during extended operations.³⁵⁵

The report illustrates the stress that the increased operational tempo put on the USS *Wright*. The inadequacy of seaplane tenders was another reason for the developmental stagnation of offensive long-range patrol scouting for the fleet before 1935.

During Fleet Problem XVI, the limitation of seaplane tenders forced VP personnel to create a base camp and provide berthing ashore on remote base islands:

Though not strictly a landing force operation a base camp was established at Midway Island for the subsistence of patrol squadrons participating in Fleet Problem XVI. Sufficient expeditionary force equipment was transported by the USS *Beaver* and *Avocet* to establish a base housing, at its peak load, 354 men and officers. The camp was self-sustaining except for provisions sent daily from the *Beaver*. The equipment included cooking stores and utensils, cots tents, Mess units, water monkeys, a fabricated radio signal tower. Camp operations were entirely satisfactory throughout the stay ashore.³⁵⁶

The lack of suitable tenders continued to be a point of contention throughout the interwar period and it was not until the late 1930s that the force was augmented with the seaplane improvement program of 1937 to 1938.³⁵⁷

By 1936, the strength of the patrol planes in the Base Force had reached fourteen squadrons operating approximately 110 aircraft.³⁵⁸ With no improvement to the quality or in the number of tenders, conditions for VP personnel conducting advanced base

³⁵⁵ Annual Reports of Commander, Base Force, U.S. Fleet to Commander in Chief, U.S. Fleet for the period 1 July 1934 to 30 June 1935, 3, NARA, Annual Reports.

³⁵⁶ Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1934 to 30 June 1935, 6, NARA, Annual Reports.

³⁵⁷ Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1936 to 30 June 1937, 14-15, NARA, Annual Reports.

³⁵⁸ Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1935 to 24 June 1936, 8, NARA, Annual Reports.

operations reached an all-time low. The annual report from the Commander, Base Force U.S. Fleet, makes note of the conditions that personnel were often subjected to during advanced base operations prior to the seaplane improvement program:

The hygienic conditions have been satisfactory except for overcrowding aboard the tenders during advanced base operations. The latter being more a question of comfort than hygienic consideration if operations were conducted under weather conditions which interdicted personnel sleeping on deck.³⁵⁹

The persistent problem of fielding aircraft tenders to support the patrol planes in advanced base operations was not solved until 1937 with the adoption of the seaplane improvement program, which transferred *Langley* to the Base Force and supplied four converted destroyers to the Scouting Fleet for operational support.³⁶⁰

By 1936, the Base Force was able to report that advanced basing concept was an operational reality despite the shortcomings in range and reliability of the P2Y aircraft and the inadequacy of tender support.

A comprehensive improvement program for the seaplane tenders which has now been undertaken by the department will yield the best that can be obtained within the design limitations of this class of converted minesweepers. The effectiveness of the patrol squadrons has been greatly augmented by the transfer of the *Langley* to the Aircraft base Force. The special facilities provided by her conversion from a carrier has already proven satisfactorily. The airplane fueling equipment especially in the *Wright* and all the seaplane tenders should be modified to accelerate the rate at which filtered gasoline in large quantities as required by the new, high capacity PBY patrol planes can be supplied.³⁶¹

³⁵⁹ Annual Reports of Commander Base Force to Commander in Chief, U.S. Fleet for the period 1 July 1935 to 24 June 1936, 16, NARA, Annual Reports.

³⁶⁰ Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1936 to 30 June 1937, 14-15, NARA, Annual Reports.

³⁶¹ *Ibid.*, 14.

The addition of *Langley* in 1937 was followed by the four converted destroyers to augment the tender force.

By 1938, the majority of the obsolete P2Y aircraft had been replaced by a PBY variant. In addition, the material problem of the aircraft tender had finally been solved. The material solutions to range came after naval leadership had refined the operational model to effectively employ patrol squadrons from advanced bases as long-range scouts. This was due to the experience and standardization gained from the participation of VP squadrons in the annual Fleet Problems.

The development of patrol aviation after the London Naval Conference was ultimately advanced in the three areas of strategic necessity, technological development, and operational experience. Naval leadership in the form of the Op12, BuAer, the General Board, and the command structure of the U.S. Fleet all served to shape the strategic role, technological ability, and organizational structure of patrol aviation during the latter part of the interwar period, “To create, maintain and operate a navy second to none in conformity with ratios established by treaties limiting naval armaments.”³⁶²

Following the London Naval Conference, the Navy spent the 1930s developing the capability of long-range offensive aerial scouts to accommodate treaty restrictions and develop a fleet that was second to none. The re-organized VP squadrons evolved and expanded during the 1930s as naval planners utilized the efficacy of technological, organizational, and operational innovations to solve the problem of how to maximize the treaty fleet to support the Orange War Plan.

³⁶² Annual Reports of Commander in Chief, U.S. Fleet for the period 1 July 1932 to 10 June 1933, 14, NARA, Annual Reports; Kuehn, *Agents of Innovation*, 199.

CHAPTER 6

CONCLUSION

The goal of this thesis was to perform an historical investigation of the influential forces that shaped the development of patrol aviation during the interwar period, 1918 to 1941. The research approaches these influential forces through an investigation from a strategic, technological, and operational perspective. Evolution of War Plan Orange and the building of the treaty navy were ultimately the driving forces that created the need for a self-sustaining, long-range, aerial patrol, and reconnaissance capability. For the naval leadership whose labors developed this enduring capability, the requirements of War Plan Orange guided their efforts toward a common strategic goal. Conversely, the restrictions of the treaty system served to shape the method of attainment. These two factors helped focus the strategic, technological, and operational solutions to the problem of developing patrol aviation for nearly a quarter century.³⁶³

The pursuit of a new strategic paradigm in the early 1920s transplanted patrol aviation from the Atlantic to the Pacific theater. However, development was slow to materialize beyond the operational model using the tactics and technology of WWI. Evidence shows that this period of development was shaped by the outside influences of

³⁶³ Till, 203-205. The Americans (and Japanese) developed naval air power during the interwar years with a distinct strategic goal in mind. “The American ability to point at the Japanese as a clear potential opponent was an asset in many ways.” The strategic focus of future conflict in the Pacific led to a unity of effort that served as an impetus to carrier innovation and that the United States was bonded with a “collective sense of mission.”

the post-war drawdown along with the challenges of reorganization and relocation of the fleet as it complied with the directives of General Order-94 in 1922.³⁶⁴

The treaty system, starting in 1922 with the restrictions of the Washington Naval Conference, also served to focus the strategic development of the fleet toward a self-sustaining force independent of permanent bases. For patrol aviation this translated into the operational concept of advanced basing which, for both the flying boats and the rigid airships, required the support of tenders. Because of the Fortification Clause XIX in the Washington Treaty, the Navy pursued a force that could operate at sea without support from forward bases. From 1922 to 1930 prioritization for embarked aviation in support of this sea based strategy focused naval planners on carrier aviation and scouts launched from capital ships to solve for the problem of tactical scouting. Technological difficulties in the range and reliability of flying boats and rigid airships along with the continued deficiencies in tender operations kept patrol aviation in an experimental stage of development.

The 1930 London Naval Conference further restricted the tonnage of cruisers, submarines, and aircraft carriers. By default, naval leadership was forced to turn to patrol aviation to fill the capabilities gap in long-range reconnaissance caused by the London Conference. This catalyst brought the strategic necessity of patrol aviation to the forefront of the war planning effort. The Navy spent the next eleven years refining the technological development for patrol aviation and its operational integration with the fleet. This effort culminated in the selection of the heavier-than-air program as the solution for offensive long-range scouts that could operate with the fleet from advanced

³⁶⁴ Allen, 2.

bases. The reprioritization of naval leadership after 1930 served to refocus planning efforts for strategic, technological, and operational development of patrol aviation. This resulted in the capabilities eventually encompassed by the PBY Catalina and an improved force of supporting tenders. This successful operational combination would be the foundation for long-range scouting that the Navy took to war in 1941.

The challenges of shifting strategic priorities, technological difficulties, and operational integration were met with working solutions by the contemporary naval leadership of the period. The leadership was organized within a horizontal structure that, sometimes at the cost of efficiency and failure, maximized innovation and developmental flexibility. This organizational structure did not function as hierarchy. The General Board had no official authority over the implementation of its resulting recommendations. The fleet had no authority over the types of aircraft that BuAer developed and procured. The strength of this organizational construct lay within its ability to collaborate and solve problems while preserving a unity of effort. The historical evidence highlights how naval leadership was consistently faced with new restrictions and compelled to re-evaluate its priorities in order to move forward with viable solutions. While the interwar period contained its share of failure, futility, and even tragedy (in the case of the rigid airship program), it is perhaps this decentralized, horizontal organizational structure that enabled such flexibility and innovation.

The General Board was the forum for the discourse that founded the operational concepts and strategic requirements set forth by the Op12 war planners transitioning their focus from the lessons of one conflict (WWI) to the expectations for the next (War Plan

Orange).³⁶⁵ This highest forum of naval leadership was able to shape and focus the development of patrol aviation at the strategic, technological, and operational level. Over twenty years of hearings translated into a running dialogue that was able to continually refine the direction of the Navy and the place of patrol aviation within its developing air arm.³⁶⁶ The General Board was where restrictions set forth by the treaty system were solved by the foremost experts on the subject matter in question.

BuAer was another important component in the horizontal structure that allowed naval planners both the freedom and the organizational authority to create the long-range patrol arm of naval aviation in the interwar period. The pursuit of both heavier-than-air and lighter-than-air technology illustrates the risks that Navy leaders were willing to assume in order to achieve their strategic ends.

BuAer linked strategic technological requirements to the design and procurement process. The leadership of Admiral William A. Moffett, Rear Admiral Earnest J. King, and their successors at BuAer nurtured the relationship between the federal government and the private aircraft industry from a union that was strained and immature to a closely knit naval air-industrial complex capable of unrivaled growth.³⁶⁷ The efforts to maintain the delicate and ever-changing balance achieved by BuAer, the federal government and the private aircraft industry came to fruition with the tenacious rigid airship program and the large-scale production of the PBY Catalina in the mid-1930s.

³⁶⁵ Kuehn, *Agents of Innovation*, 8-9.

³⁶⁶ *Ibid.*

³⁶⁷ Trimble, *Wings For the Navy*, 69-72.

Operational leadership in the form of CinCUS was responsible for integrating the strategic and technological solutions of the General Board and BuAer into an operational reality. CinCUS represents another component of the horizontal organizational structure that conceived, developed, and integrated patrol aviation into the fleet. The U.S. Fleet itself was the proving ground for the integration of patrol aviation into the operational force structure that evolved to form the treaty navy.

The example set by the Scouting Force as it exercised its flying boats with Bird-class seaplane tenders in the Caribbean was the first proof of the advanced basing concept. Another area of organizational development was the cultivation of the fledgling VP squadrons by the Base Force after the 1933 reorganization of the patrol squadrons from the Scouting Force and Battle Force.³⁶⁸ The Base Force, under the command of Rear Admiral Earnest J. King, standardized the VP squadrons and formalized their technological capability into an operational force. The majority of the operational growth during the interwar period took place at sea in early Tactical Fleet Exercises or the later Fleet Problems while patrol aviation was under the control of the Base Force.³⁶⁹ The spirit of utility exhibited by CinCUS throughout the interwar period indicates a high degree of coordination and unity of effort within the overall developmental structure of the Navy in its construction of the treaty fleet.

The interwar development of patrol aviation is an example of how naval leadership was able to balance the requirements of War Plan Orange with the restrictions

³⁶⁸ “Naval Aviation Policy: Fleet Aviation,” 15 May 1919, NARA, PHGB, 1919, vol. 3, 960.

³⁶⁹ Annual Reports of Commander, Scouting Force U.S. Fleet to Commander in Chief, U.S. Fleet for the period 1 July 1932 to 15 May 1933, 7, NARA, Annual Reports.

of the treaty system. The effort to achieve this balance provided an enabling strategic capability whose enduring effect upon the U.S. dominance of the sea contains an historical significance that is permanently moored to the relevance of contemporary patrol aviation today.

Other Observations

In the process of answering the primary and secondary questions, the historical research also uncovered some related observations that are worth noting. From 1919 to 1933, the Scouting Fleet's innovative pursuit of the mothership seaplane tender-flying boat combination to integrate patrol aviation with the fleet at sea was the proof of concept for advanced basing. The fact that the Scouting Fleet experimented with much of the earliest innovation for advanced base operations is ironic since the Battle Fleet based on the west coast was supposedly the strategic epicenter for naval aviation development with respect to War Plan Orange. The evidence suggests that since the Scouting Fleet did not have the luxury of aircraft carriers it chose, in the spirit of utility, to innovate with its patrol planes and seaplane tenders.

Another observation from the research was more abstract but nonetheless worth expanding upon. The idea that failure was not an option did not seem to apply to the BuAer approach to patrol aviation. Despite the overwhelming difficulties, the rigid airship program is an example of how tenacious BuAer was in its pursuit of even the possibility of developing a superior technological advantage. This scale of development required a certain amount of failure to succeed. The quarter century of trial and error with respect to interwar development of naval aviation in general is a testament to the acceptance of failure as part of forward progress and a necessary price for innovation.

Every interwar naval aviator who took to the sky was willing to accept that price for innovation. Some of these pioneers, like Admiral William Moffett and hundreds like him, sacrificed their lives for it.

The successes and failures of the rigid airship program highlight a common thread that was observed but not directly supportable by historical evidence. The risk of failure was accepted and even expected to some degree; and its mitigation was not given the kind of prioritization that is demanded in the Navy at the time of this writing. This is an interesting cultural observation from a period that was defined by drastic fiscal restraint, political scrutiny, and exponential technological growth.

The last observation relates to the contribution of the Base Force to the development of patrol aviation in the latter half of the interwar period. The 1933 reorganization of the patrol squadrons under command of the Base Force was supposed by some historians to be a punitive period of waiting for a technological solution in the form of the PBY Catalina. Evidence shows that the majority of the key technological and operational innovations for the VP squadrons took place during its assignment to the Base Force. The fact that the up and coming BuAer Chief Rear Admiral Ernest King, Moffett's handpicked successor, was assigned to command the Base Air Force supports this suggestion. This period contained the most definitive advances of the entire interwar period vis-à-vis fixed-wing patrol aviation development

Areas for Continued Research

The investigation of the primary and secondary sources provided an adequate foundation to conduct the historical inquiry required to effectively answer the primary research question. However, the gaps in research either delimited or discovered during

the investigative process revealed areas requiring further research to more fully understand the topic.

In order to fill gaps in the primary research it will be necessary to analyze the Reports of the Joint Board. These reports may shed more light on the influences that the Army/Navy relationship had on strategic and operational evolution with respect to patrol aviation. An investigation of BuAer correspondence will also serve to illuminate the design and procurement process as it pertains to the civilian aircraft industry.

The research process raised questions that, because they have fallen outside of the scope of this investigation, remain unanswered. Material inadequacies of tenders were present for the entire period. The deficiency of seaplane tenders were reported to the highest levels of Navy planners and are evident in both the General Board hearings as well as the Annual Reports of the Commander in Chief. Why could they not be remedied?

The deficiencies of the seaplane tenders, coupled with the overhaul interval of the flying boats, gave the VP squadrons a finite period of effective operation from advanced bases. Could this have been a compelling reason why Admiral Kimmel kept his entire contingent of VP squadrons (sixty-nine VP aircraft) on the ground on 7 December 1941? Were VP seen as a temporary expeditionary capability because of their lack of tender support and overhaul cycle (approximately two weeks)? If this were the case, it would be understandable for a commander who was expecting an offensive drive into the southwestern Pacific, to husband his VPs in a preserved state of readiness.³⁷⁰ Was it the evolution of VP operations and the “11th hour” shift of the patrol wings back to the

³⁷⁰ Miller, “Eyes of the Fleet,” 41-42.

Scouting Force in 1937 that created the conditions for neglecting to utilize such an obvious reconnaissance capability on the eve of 7 December? These matters require further investigation.

Final Thoughts

While the historical evidence highlights the causal relationships of War Plan Orange and the treaty system on the development patrol aviation, the influence of these two factors are not the full story. The larger discovery lies in the way that the naval leadership persevered through the challenges set by both requirements of the War Plan and restrictions of the treaty system. The successes and failures illuminated by the historical investigation can be examined for contemporary reflection. Innovation and change is a cultural hallmark of naval aviation. In a time defined by dynamic strategic environments, fiscal austerity, exponential technological growth, and operational modernization, the examples set by interwar naval leadership are more relevant than ever.

The strategic need for long-range multi-mission aircraft in support of the fleet has not changed with time. Patrol aviation has grown from flying boats to the P-8A Poseidon. Challenges with strategic inertia, technological evolution, and their operational balance will always be persistent hallmarks of naval service. The successful interwar evolution of patrol aviation holds implicit the merit of a maritime culture that is innovative, resourceful, and industrious; the effects of which have endured as substance of character within the U.S. naval service from well before the invention of the aircraft. The better we can understand the determinants of innovative change, the better we can hope to retain the weight of its virtue. It remains in our vital interest to do so.

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